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SAFETY IN HOUSE-DRAINAGE.

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IT was a little more than five years ago that Dr. Frank Hastings Hamilton wrote for "The Popular Science Monthly" an article on sewer-gas, in which he vigorously arraigned science for its failure to keep pace with civilization in the disposal of household wastes. The effect of Dr. Hamilton's article was quite unprecedented. His forcible presentation of facts and theories so affected the popular mind as to create an almost universal distrust of sanitary science, and, even at the present time, the idea prevails that plumbing fixtures in our houses are always a source of danger. In magazines and newspapers the discussion has been from time to time renewed, and the same pessimistic views are almost invariably held that were first advanced by Dr. Hamilton.

It is a subject of vital interest now to determine if this unfortunate condition of things described as existing five years ago still continues. We should know the truth or falsity of the assertion that there has been in late years a retrograde movement, hygienically considered, in substituting house-drains and sewers for the old earth-vaults and cess-pools. Can we have plumbing fixtures in our houses without danger to health, or must we make great concessions in comfort and convenience for the sake of safety? The question has lost none of its interest since Dr. Hamilton called into question the trustworthiness of sanitary science. Let us examine the evidence upon which the indictments have been made. We shall find, in the first place, that there is a surprising popular ignorance in regard to the literature of the science. How many well-informed persons are there, who know of the work of Pettenkofer, of Carmichael, of Naegeli, and Wernich,

and Miquel, and a score of other scientists abroad, whose investigations have added so much to our knowledge of specific dangers to health and the means of overcoming them? And how many have heard of the careful and painstaking sanitary work of able scientific authorities in the United States? The labors of Waring and Putnam and Pumpelly and Smyth have been no less valuable, but the records of their investigations and experiments, although of great popular interest, are not widely known. No one can speak or write intelligently on sanitary topics without familiarity with this literature; but the writers who have arraigned sanitary science so severely are those who are most ignorant of its methods and its principles.

Let us consider the popular notion already alluded to—that we can not safely have plumbing fixtures in our houses. It is evident that the present requirements of comfortable living demand a reasonable number of convenient baths, closets and basins, and all the usual apparatus of this kind which modern civilization has introduced into the houses of the well-to-do. We can hardly consider these as luxuries. They are, in fact, absolute necessities; and to dispense with them would cause great inconvenience and inconceivable loss of comfort, and even of health. In compliance with the demands of a high civilization, sanitary science has been directed persistently toward the perfection of means to obtain all possible conveniences for free and frequent ablutions, as well as for the immediate and complete removal of household wastes. What evidence is there that science has failed in this particular? It is said that costly houses fitted with elaborate and expensive appliances for luxurious living have been often invaded by disease and death, and that the cause of this has been sewer-gas. These facts can not be disputed, but it is absurd to claim that science is at fault in this matter. The unfortunate results of such cases are invariably due to ignorance and empiricism.

In his census reports, Dr. Billings estimates that, in the United States, one hundred thousand deaths occur every year from strictly preventable diseases alone. This is unquestionably a very moderate estimate, and, if there are reckoned also twelve cases of serious illness for every death, we see what a great amount of suffering results from ignorance of sanitary principles.

But how is this ignorance manifested? Are not our architects competent to deal with the problem of household sanitation? It will be said, perhaps, that it is the province of the architect to direct the entire work of house-building, and to arrange every detail of the fittings. But it should be considered that the science of sanitation is broad and comprehensive. Years of study and of experience in sanitary work are necessary for a proper under-

standing of the subject. It is perhaps unfortunate that there is so little in the severe and unpleasant details of this work to commend it to those whose tastes have led them to the study of the more attractive principles of artistic construction and the science of æsthetics. An architect should have the soul of an artist, but there are few men whose nature is so broad as to combine truly artistic tastes with a love for the details of difficult mechanical work, involving the necessity for undertaking comprehensive and exact scientific research. It is the province of the engineer to engage in an occupation of this kind. His natural inclinations and his rigid training in scientific pursuits fit him especially for the direction of matters relating to drainage and sewage disposal.

If we take the testimony of competent sanitary authorities who are constantly employed in the design and execution of systems of house-drainage, it will be found that there are very few architects who can be trusted to prepare specifications for plumbing. In fact, the work of the average architect, in planning and supervising constructions of this kind, has been found to be almost universally clumsy and unscientific. This has been the experience of the writer in almost every case where his services have been called into requisition to remedy serious defects in household drainage which have sometimes caused inconceivable loss and misery. In this connection there may be quoted some pertinent remarks of one of our best known and most reliable sanitary authorities, Colonel George E. Waring, Jr., who recently wrote: "I have had much experience in connection with plumbing work in houses designed and built by some of the first architects of the country, and I do not hesitate to say that, in my experience, I have not found a single case where the architect has made use of the plainest and best developed knowledge of the day on this subject. I may be mistaken, but I think that no architect with whose work I have had to do either wrote or understood the specifications under which the plumbing was to be done."

Perhaps we shall be able to see now a little more clearly why some of our most costly dwellings are veritable whited sepulchres. But what of the plumbers? How is their status to be defined in this connection? From motives of economy, a plumber is sometimes employed to take charge of an entire scheme of house-drainage, and the employer intrusts everything to his care. The unfortunate results of such confidence are seen continually in the unsanitary condition of innumerable houses of rich and poor alike in all of our large cities. There is hardly a parallel to be found in any other occupation where men handle implements of death with such recklessness and with such disastrous consequences. The plumber is a mechanic, and perhaps a tradesman. His opportunities for study are few, and his inclina-

tions are rarely toward self-improvement or useful learning. He blindly considers it his interest to induce his customers to allow him to use the greatest amount of material possible in his work, and the greater the complication of arrangement of pipes and fixtures with the consequent mystification of his patrons, the

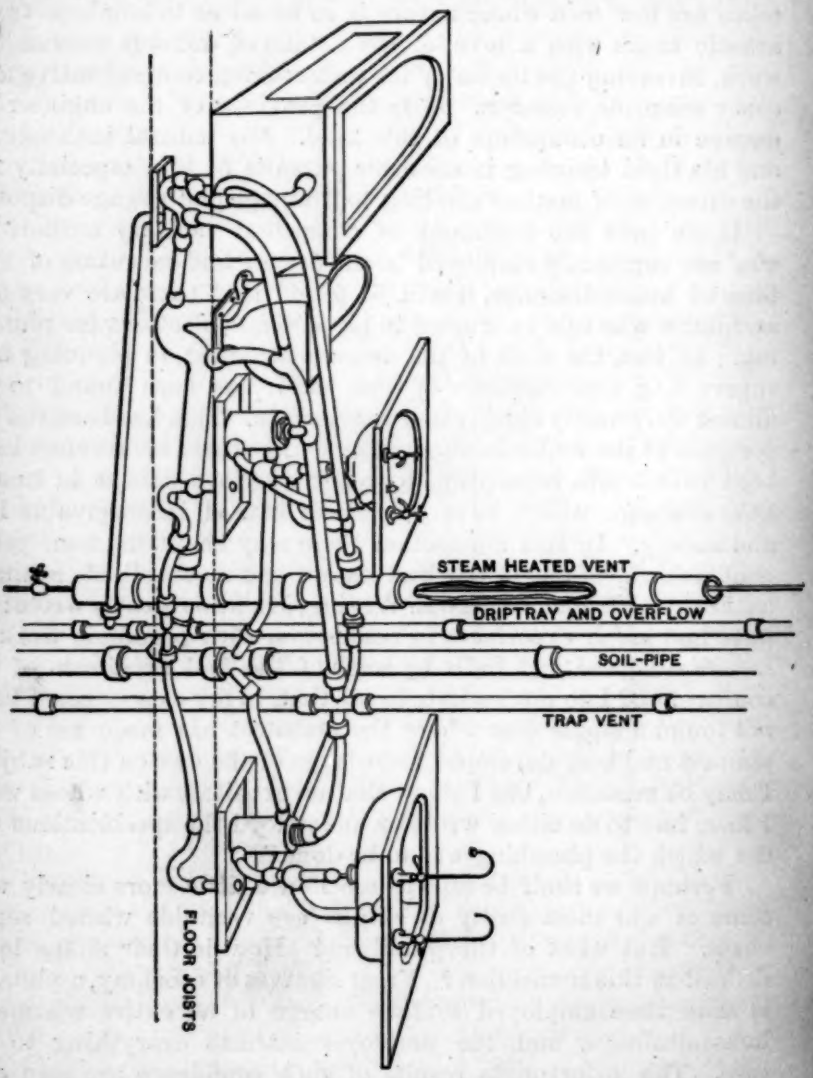

FIG. 1.—SHOWING THE ACTUAL ARRANGEMENT OF WASTE-PIPES AND VENTS ABOUT A GROUP OF PLUMBING FIXTURES IN A HOUSE IN NEW YORK CITY. There are sixty-three joints.

more absolute becomes his power, with largely increased possibilities of extra charges.

Compare the plumber and his "helpers" with the young mechanics in almost any good machine-shop, and decide which occupation engages young men of greater intelligence and skill in manual work. Obstinately following tradition, our plumbers

generally regard all improved methods developed by the application of scientific principles as dangerous innovations, interfering with the ancient and time-honored traditions of their unprogressive fraternity.

There is another and a stronger obstacle to scientific progress in

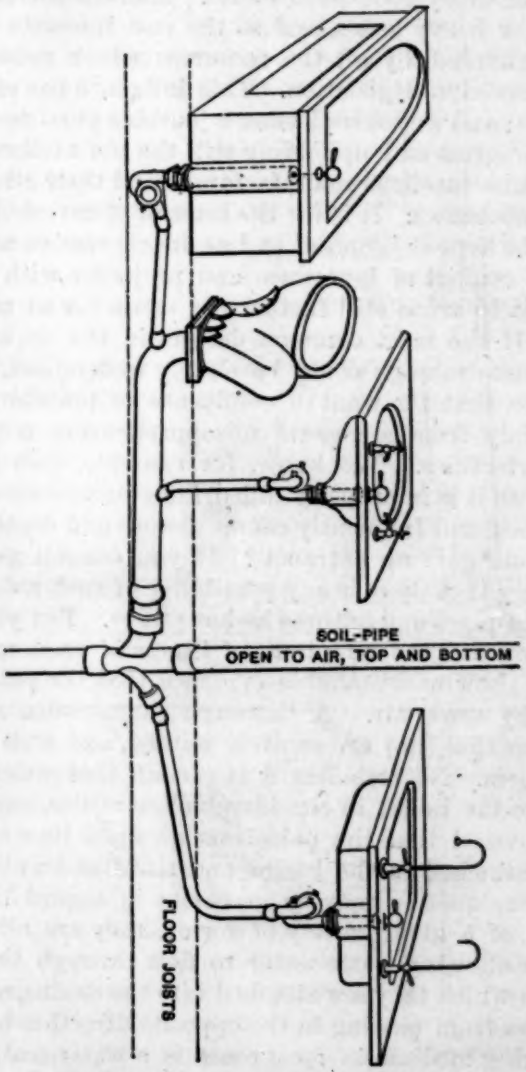

FIG. 2.—THE SAME FIXTURES, WITH THE PROPER ARRANGEMENT OF WASTE-PIPES.

sanitary matters. This is to be found in the powerful influence of capital. In our large cities are the extensive wholesale establishments of dealers in plumbing fixtures and supplies. The amount of money invested in the stock and patterns for manufacturing certain forms of plumbing appliances is enormous. These articles are, many of them, extremely unsanitary and even danger-

ous when applied to actual use, but the profits on their sales are large, and the introduction of better and more simple forms of apparatus would seriously disarrange the existing order of things. The abolition of the trap-vent laws, for example, would cut out a thousand pounds or more of useless iron and lead pipes from the plumbing of every good-sized house. Manufacturers and dealers would suffer heavy losses, and so the vast interests involved are carefully guarded by all the resources which money can command in municipal legislation. This influence has extended even to the press; and we see tradesmen's journals persistently ignoring scientific progress and upholding still the old methods which are to enrich unscrupulous manufacturers and their clientage of uneducated mechanics. It is for the interest of invested capital that plumbers be kept as ignorant and as unprogressive as possible.

In this conflict of ignorance and prejudice with science, it is not difficult to trace still further the cause for so much popular distrust. If the most common defects in the apparatus for ordinary house-drainage could be clearly understood, it would be readily seen that the want of confidence in plumbing appliances arises mainly from a general misapprehension regarding their real imperfections. We know, for example, that sewer-air, or sewer-gas, as it is improperly called, finds its way continually into many houses, and frequently causes disease and death. How does this sewer-air gain an entrance? If you consult your plumber, he will deny that there is any possibility of such a defect existing in the drain-pipes and fixtures he has put in. But your physician will tell you that the symptoms of illness of some member of the household show unmistakable evidence that the patient has been poisoned by sewer-air. A thorough examination of the drain-pipes shows that they are securely jointed, and that there are no leaks in them. Nevertheless it is certain that sewer-air gains an entrance to the house in considerable quantities, and after a time it is discovered that the poisonous air finds its way in through the traps attached to the basins and sinks and water-closets. A word of explanation may be necessary in regard to these traps. Although of a great variety of forms, they are all essentially a device for allowing waste-water to flow through them from the fixtures to which they are attached into the drains, and to prevent air or gases from passing in the opposite direction into the house. The resisting medium in most cases is a water-seal, consisting of a small body of standing water in the body of the trap. When it is found that sewer-air passes freely through these very traps that have been designed to keep it out, the inference is almost irresistible that the water-seals are at fault, and that water is not a suitable medium to be used for this purpose, since air from the drains apparently forces an entrance through it.

It is at this point that the serious error of a false assumption is so frequently made. The truth is, that sewer-air does not come into our houses in any appreciable quantity through the water-seals of traps. On the contrary, it passes through the trap when the seal has been lost—when the water has been accidentally withdrawn or forced out. The broad principle of the efficiency of water-seals is not affected by these apparent failures. The difficulty is in maintaining the seals—in keeping them intact and secure against all the various adverse influences that may affect them. And here the aid of sanitary science must be sought; for the plumber's art has been powerless to devise traps that will protect our houses from the foul air of the sewers. Every failure in this attempt has been from a disregard of principles that have been well established by competent authorities. What are these principles?

For many years, skillful chemists, devoting themselves to sanitary work, have been carrying on careful investigations regarding the possibility of the passage of sewer-air and disease-germs through the water-seals of traps. The definite determination of this question is necessary in order to establish proper means of defense against the dangers we have already considered. It is evident that the form of traps and other apparatus to be used for this purpose will depend upon a conclusive demonstration of the truth or falsity of the views of those who have maintained that water as a resisting medium gives no protection in this particular The evidence which we have upon this point is clear and conclusive.

As long ago as 1877, Naegeli, an eminent scientific authority in Munich, established conclusively that disease-germs can never be given off from a liquid at rest in any ordinary temperature. Later researches by Carmichael, Wernich, and Miquel, chemists and sanitarists of world-wide reputation, corroborated the truth of Naegeli's demonstrations in every respect.

In 1880 the United States National Board of Health, through the efforts of Colonel George E. Waring, Jr., secured an appropriation for the purpose of investigating the same subject. Two able chemists, Prof. Raphael Pumpelly and George A. Smyth, Ph. D., were employed to conduct the investigations. A long series of careful and delicate experiments was made, extending through several months, and the published report of the results forms a valuable contribution to the literature of sanitation. The conclusions in this instance are precisely the same as those of the other authorities above referred to—viz., that disease-germs can not be given off to the air from any quiescent liquid at a normal temperature.

The experiments of Dr. Neil Carmichael, Fellow of the Faculty

of Physicians and Surgeons at Glasgow, are particularly interesting. They were conducted with rare skill and an honest endeavor to ascertain the worst conditions existing ordinarily in houses containing the usual forms of plumbing fixtures. Dr. Carmichael attached his experimental apparatus to the traps of two common water-closets connected with a foul soil-pipe leading into an old sewer. The outlet of this sewer, some three hundred yards away, was submerged at high tide, so that sewer air or gases were forced back toward the houses. The top of the soil-pipe used for the experiments was ventilated by a two-inch pipe passing through the roof to the outer air; and, to impose the most severe conditions possible, some of the experiments were conducted with the soil-pipe tightly closed at the top. The average result of many different experiments by Dr. Carmichael is given in the following table:

Quantitative Determination of Gases which passed through Water-Traps (A and B) in Twenty-four Hours.

GAS.		Old water-closet trap (A).	Kitchen trap (B).
		Grains.	Grains.
Soil-pipe open at the top...	Carbonic acid.....	7·084	7·084 10·470
	Ammonia.....	$\frac{1}{17}$, $\frac{1}{20}$, $\frac{1}{30}$, $\frac{1}{100}$	$\frac{1}{10}$, $\frac{1}{20}$
	Sulphureted hydrogen .		$\frac{1}{50}$
Soil-pipe closed at the top...	Carbonic acid.....	32·032	17·063
	Ammonia	.....	$\frac{1}{100}$
	Sulphureted hydrogen .	$\frac{1}{90}$	.....

Putrid organic vapors, if present, are included in the ammonia.

With the top of the soil-pipe closed, it will be seen that the amount of gases passing through the water was considerably increased, but was still extremely small. And this represents the worst possible condition that can exist in houses which are properly protected by traps having water-seals.

The deductions of Dr. Carmichael from these experiments are here given in his own words, taken from the "Proceedings of the Philosophical Society" of Glasgow:

"These are the quantities of the only sewage gases existing in the soil-pipe in estimable quantities which pass through an ordinary water-closet trap in twenty-four hours. Diffused into the atmosphere of a house during this time, these quantities are, from a health point of view, quite inconsiderable—perfectly harmless. Thirty-two grains (the largest quantity of carbonic acid) is less than the quantity of the same gas given off when a bottle of lemonade is opened. A man exhales in the same time about four hundred times the amount which passes through the trap from an unventilated soil-pipe."

Dr. Carmichael then explains in detail his experiments in re-

gard to the passage of disease-germs through traps, and concludes as follows:

"The liquids in all these tubes and flasks, though kept from two to five months at cultivation temperature, have remained perfectly clear, and even when examined with a lens multiplying nine hundred diameters, exhibited no trace of life. The conditions of these experiments seem to me crucial, and to warrant the conclusion that germs do not pass through a sound water-trap. If no germs pass through, then it is certain that no particles pass through, because the particles in a soil-pipe are putrid, and because the passage of organic particles through water necessarily impregnates them with germs. Clearly, therefore, such particles as epithelium from the bowels in typhoid fever, containing the typhoid contagia, are cut off and effectually excluded from the house by a sound water-trap. Water-traps are, therefore, for the purpose for which they are employed—that is, for the exclusion from houses of injurious substances contained in the soil-pipe—perfectly trustworthy. They exclude the soil-pipe atmosphere to such an extent that what escapes through the water is so little in amount and so purified by filtration as to be perfectly harmless; and they exclude entirely all germs and particles, including, without doubt, the specific germs or contagia of disease."

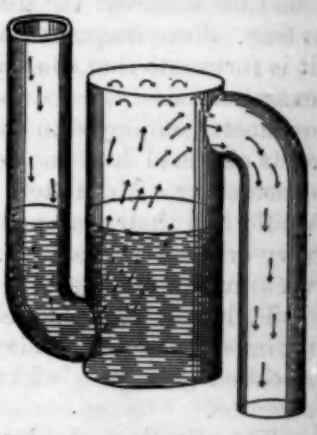

FIG. 3.—A POT-TRAP, SHOWING HOW WATER ESCAPES BY SIPHONAGE.

The testimony of these distinguished scientists must be regarded as conclusive in the absence of contradictory evidence. Is there such evidence on record? Let us examine the authorities. It is claimed that different results have been obtained in a few instances by other investigators. Some years ago, Prof. Doremus showed that gases would pass through water from one test-tube to another. But it must be remembered that the gases used in these experiments were in a highly concentrated form. Such conditions as were then imposed are absolutely impossible outside of the chemical laboratory. The atmosphere of sewers, drains, and soil-pipes is in reality ordinary air containing less than one per cent of the gases and particles given off by decomposing sewage. The results of over sixty analyses made by such men as Dr. Letheby, Dr. Miller, of London, and the late Prof. Nichols, of Boston, show an average of only four tenths of one per cent of carbonic acid with mere traces of sulphureted hydrogen, marsh-gas, and ammonia. The putrid organic vapors, and the putrefactive

germs, particles, and spores of fungi, were found also in extremely minute quantities. But the important consideration is, that these germs, particles, and spores, the most dangerous elements of sewer-air, can not escape from the water-seal, and that the quantity of carbonic acid, and the accompanying gases arising from sewer-air, which, even under the worst conditions, can pass through water, is minute and utterly harmless. The experiments of Prof. Doremus were therefore irrelevant and valueless as applied to a determination of the efficiency of trap-seals.

It has been said, too, that Mr. Paton, a chemist temporarily in the employ of the health department of the city of Chicago, at one time observed the passage of sewer-gases through the seal of a trap. Since frequent reference has been made to this experiment, it is fortunate that the report of Mr. Paton is still accessible. An examination of the document in question, and of a drawing of the apparatus employed in the experiment, shows at once that the results obtained have no relation whatever to the subject we are considering. Mr. Paton, instead of trying to ascertain if gases would find their way unassisted through a trap-seal, adopted the very original method of forcing them through the water into a vacuum by atmospheric pressure. A more absurd proceeding could hardly be imagined, were it not for the fact that these experiments were in reality conducted to determine the value of a so-called germicide which the health officers had been asked to examine.

There is, then, absolutely nothing in the form of reliable testimony that can be brought forward to contradict in any particular the positive and comprehensive statements of the eminent scientific authorities previously referred to.

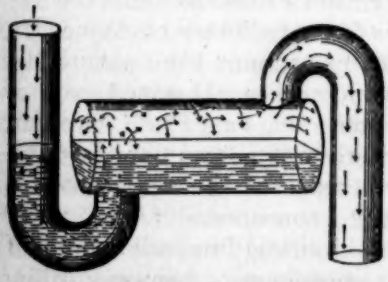

FIG. 4.—FIRST STEP IN THE DEVELOPMENT OF AN ANTI-SIPHONIC TRAP.

It is established beyond question that water may be safely used as a seal for traps. But may there not be a better and more complete medium of resistance against sewer-air? The attempt has been made to substitute mechanical valves of various kinds in place of the water; a seal of mercury has also been employed, and, in some instances, balls of rubber and of metal have been used in conjunction with water; but these substitutes and additions have, in every case, proved extremely objectionable, on account of obstructing the outward flow of waste-water, and so causing accumulations of filth in the traps and water-pipes.

It is not at all probable, then, that any better contrivance than

that of a water-seal will ever be devised for the protection of our houses from the poisonous air of drains and sewers. But, having determined this point, we find that there are still serious difficulties to overcome in making traps that will not lose their seal. In our house-drains there are always certain influences that tend to lower the water in the traps, or even to draw it forcibly out, and then, of course, with the seal destroyed, there is no protection against sewer-air. Siphonage, capillary attraction, and evaporation are among the most potent of these hostile agencies. Certain atmospheric disturbances also, such as strong draughts of air, may produce the same effect, and the trouble which has resulted from causes of this kind has, for the most part, been ignorantly attributed to the supposed easy permeability of the water as regards the dangerous gases of decomposition in our sewers.

Various means have been devised to prevent siphonage of traps. One of the most common is that of trap-ventilation or back-venting, so called. In its most common form, it consists of a system of air-tubes connected with the crown of each trap, and running by one or several lines of larger pipes to the outer air above the roof of the building. It was expected that this device would prevent entirely the siphonage of traps, and in several cities plumbing laws have been framed requiring all traps to be vented in this manner. But in hundreds of houses to-day, where this method of protection has been adopted, we find sewer-air entering freely through traps that continually lose their seal. And it will be easily seen, after a little reflection, that this fallacious remedy causes quite as serious evils as those it is designed to obviate. In the first place, if the ventilation of the trap by this method is effective, a current of air is introduced close to the water-seal, and this circulation must induce evaporation of the water in the trap, rapid in proportion to its efficiency as a ventilator, so that the seal is soon destroyed. This frequently happens to the traps of basins and other plumbing fixtures that are not in every-day use. Again, it is found that the friction of the air in the vent-pipes is sometimes so great as to prevent them from performing their proper function. In this case, where there is the slightest retardation in the passage of air through the vent, siphonage takes place and the seal of the trap is destroyed as readily as if the vent-pipes had not been used. Again, the lower orifice of the air-pipe is frequently obstructed by filth thrown up to the crown of the trap as the waste-water passes rapidly out. In time, this obstruction increases to such an extent that the vent-pipes can not give a free passage for the air, and there is consequently no relief for the seal when siphonage occurs. It should be observed, also, that in modern houses, where trap-ventilation is considered to be most perfect, there is still another set of air-

tubes, running from the inside of every trap-seal to the larger air-pipes extending through the roof of the building. With this double ventilation, the deleterious effect of air-currents on trap-seals is, of course, greatly increased.

Some idea of the complication and enormous expense of this system may be formed from an illustration of its application to a group of four plumbing fixtures in adjoining rooms on one floor of an elegant residence recently built in New York city (Fig. 1). It will be seen that the air-pipes require an almost complete duplication of the waste and soil pipes. This, of course, adds greatly to the cost of the plumbing, and increases the danger from imperfections in the largely augmented number and length of pipes with their multifarious joints.

Fig. 2 shows the same number of fixtures in the same relative position, but the plumbing is arranged in accordance with the requirements of modern methods as developed by the application of scientific principles.

Not long after the adoption of the fallacious device of back-venting, it became evident that more efficient means of guarding against the dangers of sewer-air were necessary, and persistent

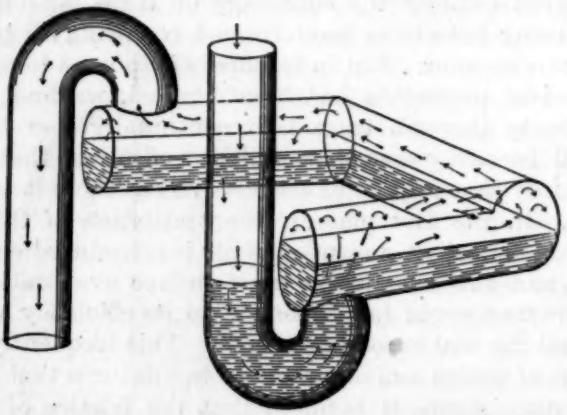

FIG. 5.—SECOND STEP IN THE DEVELOPMENT OF AN ANTI-SIPHONIC TRAP.

effort was directed toward devising better methods of house-drainage. The result has been the attainment of a new order of things by the recognition of scientific principles previously ignored.

For the development of this science, credit must be given mainly to an accomplished sanitarist of Massachusetts, Mr. J. Pickering Putnam, whose experiments and investigations on subjects relating to household sanitation are unquestionably the most thorough and complete that have ever been put on record. The first of this series of experiments was made for the Board of Health of Boston, in 1883. Subsequently, special demonstrations

were shown before the Suffolk District Medical Society of Massachusetts, the Boston Society of Architects, and others. The results have been published in the "Boston Medical and Surgical Journal," the "American Architect," the "Sanitary Record" of London, and other periodicals.

Without referring now directly to the experiments and investigations, we may consider briefly certain principles which have been established by them. The first and cardinal principle of science as applied to house-drainage is simplicity. In the place of a wilderness of pipes tangled in hopeless confusion about every fixture, modern science demands that there shall be only a simple and positive system which shall act with directness and certainty in every case. The old air-pipes from traps are discarded. There are fewer joints, and the danger from leakage is lessened. Instead of traps that easily lose their seal, notwithstanding the relief-pipes attached, traps are now used that in themselves will resist the hostile influences of evaporation and siphonage. The new system demands that basins, sinks, baths, and water-closets shall be so constructed as to act after the manner of flush-tanks, and scour the whole system of waste-pipes at each discharge. It requires that there shall be no hidden and inaccessible recesses in plumbing fixtures, where filth may collect and putrefy, so as to become offensive and dangerous. The absolute *prevention* of serious evils is considered of far greater importance than means to palliate them.

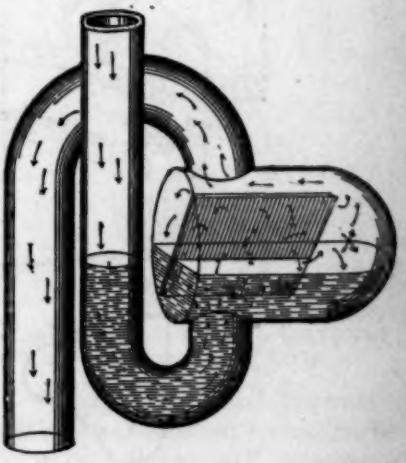

FIG. 6.—SHOWING THE PRINCIPLE OF AN ANTI-SIPHONIC TRAP.

Such, in brief, are the leading principles of the new method which are directly opposed to those of the old. We may look a little more closely into the details of their execution. Simplicity has been secured, as already stated, by the rejection of complicated vent-pipes, and by the adoption of traps secure against siphonage or evaporation. The gradual development of one form of such a trap is an interesting study, but there is space only to outline the principles upon which it is constructed.

The experiments of Mr. Putnam on trap-siphonage showed in what manner the water is withdrawn from traps by siphonic action. It was seen that air, rushing through the seal to fill a vacuum beyond, threw the water upward and outward through

the orifice of the trap into the waste-pipe, as shown by arrows in the sketch of a pot-trap (Fig. 3). It was observed, too, that a part of the water struck the top of the trap and was reflected back in the form of spray. This suggested the possibility of retaining the water in the trap under siphonic disturbance by repeated deflections from reflecting surfaces. Various experimental patterns of traps were made by Mr. Putnam, as shown in Figs. 4 and 5; and, finally, the form shown in Fig. 6 was found to be anti-siphonic and self-cleansing under all conditions that exist in good plumbing practice. It has four reflecting surfaces to deflect the water from the outlet, and the seal is so deep and the construction such as to enable it to resist both evaporation and capillary attraction.

The general principle that all plumbing fixtures shall act as flush-pots, so that the waste-pipes shall be automatically cleansed, is of great importance. A strong flushing action is secured by making the outlets of the fixtures as large as the waste-pipes

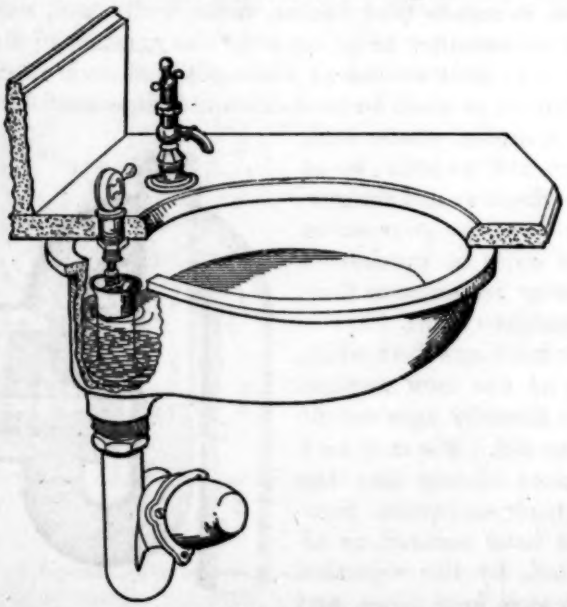

FIG. 7.—A BASIN, SHOWING THE PROPER FORM OF OVERFLOW-PIPE FOR ALL LAVATORY FIXTURES, AND THE ARRANGEMENT OF OUTLET AND TRAP TO GIVE THOROUGH FLUSHING TO WASTE-PIPES.

themselves, and by the use of traps having a free water-way, with no balls or mechanical valves to obstruct the flow of waste-water. Aëration is effected by the admission of a free admixture of air into the waste-pipes, automatically forced in by the water escaping from the fixtures above.

The abolition of inaccessible filth-collecting recesses in modern plumbing has necessitated a complete change in the construction of the old forms of appliances with which we have been familiar.

Our basins, baths, and pantry-sinks have been made with overflow openings connecting with pipes concealed from view and entirely inaccessible for cleaning. These overflow-pipes invariably become receptacles for filth, and the emanations from them are always offensive and dangerous. The new patterns of basins, sinks, and baths have the overflows in the form of a short, movable stand-pipe set in a recess at the back or end of the fixtures. This stand-pipe serves also as an outlet-plug. When raised from its seat by a simple lifting device, it permits the escape of waste-water, and by a single movement it is readily detached from its place for cleaning (Fig. 7).

The overflow-pipe of our common set-basins forms a receptacle for the accumulation of a thick deposit of filthy slime in its interior, which, by putrefying, pollutes the air of houses to a dangerous degree (Fig. 8). Since the interior of this pipe is quite inaccessible for purposes of cleansing, there is no remedy for the evil except by abandoning the use of this old form of fixture, which has also other equally objectionable features. The chain attached to the outlet-plug invariably collects a great quantity of filth in its numerous well-protected recesses and on the entire irregular surface of the links. It is almost impossible to remove this filthy accumulation by any ordinary means, and the continued use of a household fixture of this kind by different persons is offensive to good taste, and violates the generally accepted standards of personal cleanliness established by ordinary hygienic principles.

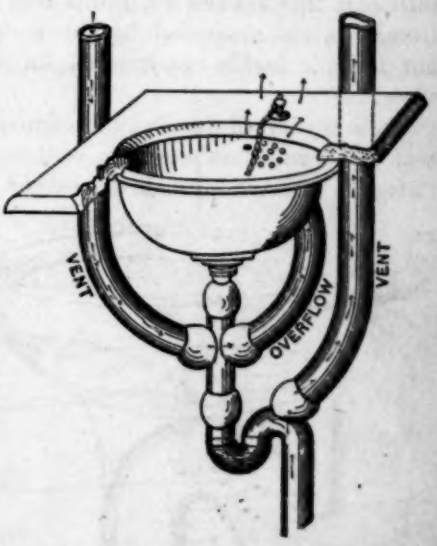

FIG. 8.—SET-BASIN, WITH COMMON OVERFLOW-PIPE AND "FORE" AND "BACK" VENTS.

Our common water-closets in general use have so many serious faults of design and construction as to demand especial consideration in this connection. Some of the most costly and elaborate patterns recently designed and put upon the market are dangerous and unfit for use. Delicately tinted and fancifully molded shapes of porcelain or earthenware are no guarantees of safety. Sanitary requirements in the construction of water-closets are so clearly defined that the essential features can be readily understood from a brief enumeration.

First of all, the water-seal must be deep—never less than four inches—and this seal must be exposed to view for reasons which will be hereafter given. Again, there must be a considerable depth of standing water in the bowl of the closet, to deodorize fecal matter and to secure cleanliness. The outlet of the bowl must also be completely submerged, to prevent its becoming foul and offensive from use. The closet should invariably have some device for maintaining the water-seal against loss from evaporation.

The traps of water-closets are especially exposed to the danger of losing their seal. This happens frequently from the effect of wind and other atmospheric disturbances. An open fire in an adjoining room, or a ventilator near by, may cause this loss of seal from sudden draughts of air, and sewer-air frequently has free entrance into houses for hours and even days at a time when the danger is not suspected by the occupants, since the water-seal of the trap, in badly constructed fixtures, is wholly concealed from view.

In a series of careful experiments, conducted by the writer, it was observed that even in well-ventilated soil-pipes, strong air-currents prevail to such an extent as to cause the water-seal of traps to fluctuate with a quick rise and fall, so that enough water is soon spilled over the outlet of traps to unseal them entirely. The results of these experiments have recently been fully confirmed by other investigators.

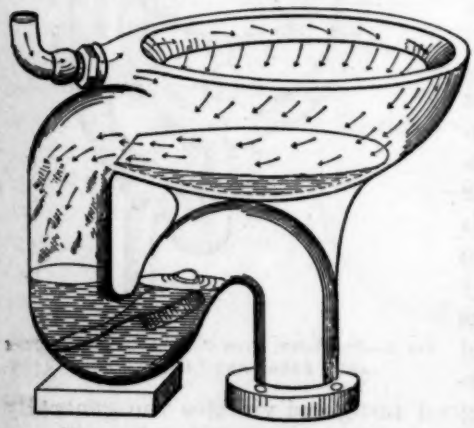

FIG. 9.—"WASH-OUT" WATER-CLOSET, SHOWING HOW ACCIDENTAL OBSTRUCTIONS MAY REMAIN UNDETECTED IN THE TRAP WHICH IS CONCEALED FROM VIEW.

Of course, the more shallow the seal, the greater is the danger of its being destroyed from any cause; and for this reason a considerable depth of water is required in the trap of every water-closet. It is necessary, also, that this seal should be plainly exposed to view, in order that any loss of water from the causes just mentioned, or by leakage, may be readily noticed.

But it will be observed that the water-closets in most common use have an extremely shallow seal. The reason of this is that, with the imperfect means employed for flushing them, a greater depth of water in the trap can not be allowed, since it would seriously retard the outward flow of waste-water. The common

"wash-out" closets, so called, with the allied forms of "short hoppers" and "long hoppers," and the complicated and dangerous "plunger," "valve," and "pan closets," all depend on the weight of a stream or body of water falling from above to force out the waste matter from the bowl of the closet through the trap below. This force is rarely sufficient to give proper flushing action, even with a shallow trap-seal. A deeper trap would oppose too much resistance to the discharge of waste matters from closets of the kind just referred to. Cleanliness and safety can be secured only by a greatly modified form of construction, and by the employment of totally different means for flushing. The principles of the siphon and of the water-jet have been applied successfully to this purpose, so that deep and safe water-seals can be used which are in full view at all times.

FIG. 10.—"SHORT-HOPPER" WATER-CLOSET, SHOWING ACCUMULATIONS OF FILTH IN THE BOWL.

The illustration, Fig. 11, shows a form of siphon closet devised by Colonel Waring. The flushing is effected by opening a valve in a tank above, which produces a quick rush of water into the bowl. This fills the longer arm of the siphon and the weir-chamber below by the overflow through the neck or short arm. As soon as this takes place, the contents of the bowl are forcibly drawn out by siphonic action and discharged into the waste-pipe, after which the normal level of the water in the bowl is re-established by an after-fill from the tank.

FIG. 11.—A SIPHON CLOSET, WITH DEEP WATER-SEAL.

There are, however, certain so-called pneumatic or siphon closets which should be carefully avoided on account of their having a double trap. This principle of construction is directly

opposed to sanitary requirements. Double traps are not permissible in any case for a single plumbing fixture, since their use greatly retards the outflow of water and waste matter, thereby causing accumulations of filth that are dangerous and offensive. It should be observed, too, that in these closets the second trap gives no additional protection against sewer-air, since a relief-pipe from the air-space between the traps opens directly into the apartment in which the closet is placed through a concealed orifice above the flushing-tank. The main trap is also completely hidden from view in a part of the closet entirely inaccessible.

Figs. 12 and 13 show a trap-jet closet devised by Mr. J. Pickering Putnam to conform to the requirements of the essential principles already stated. Its construction is extremely simple. It has a deep and perfectly protected trap-seal exposed to plain view in the bowl of the closet. The flushing-pipe stands always full of water, equilibrium being maintained by atmospheric pressure. Should the water in the bowl be lowered by evaporation or siphonage, air will enter the flushing-pipe through one of the openings at the lower end, and water immediately descends to restore the loss to the trap-seal.

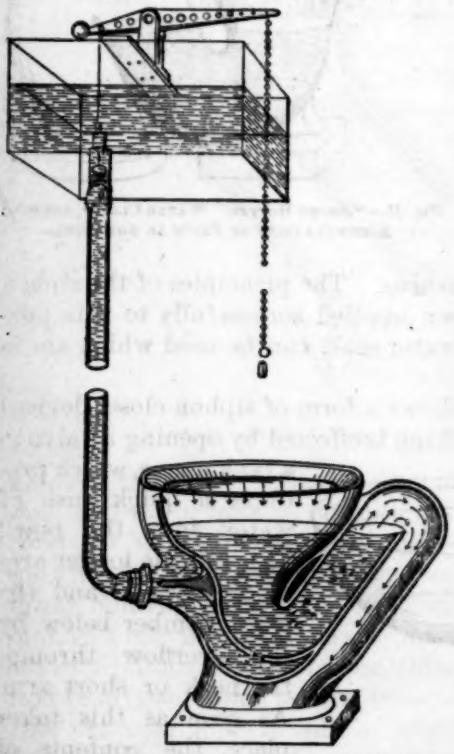

FIG. 12.—SHOWING THE PRINCIPLE OF A TRAP-JET WATER-CLOSET. For convenience of illustration the inlet and outlet are here represented on opposite sides of the bowl.

Fig. 14 shows a simple illustration of this principle in the sketch of an inverted bottle with the mouth submerged in a basin of water. The contents of the bottle remain undisturbed so long as the level of the surface of the fluid in the basin is constant; but if this be lowered, so that air enters the mouth of the bottle, a corresponding volume of water escapes from the bottle into the basin to restore equilibrium. The application of this principle of protection to houses which are closed and left untenanted during several months of the year is manifestly of great importance. Our city residents, after a summer passed at the sea-shore, or in

the fresh, pure air of the mountains, often return to houses which have upholstered furniture, carpets, curtains, and heavy draperies saturated with the foul and poisonous air of sewers and drains which has had unrestricted entrance to the deserted houses for months at a time.

It will be noticed that the lower end of the flushing-pipe shown in Fig. 12 is divided, one orifice being connected with the flushing-rim and the other with a small opening at the bottom of the

FIG. 13.—TRAP-JET CLOSET, SHOWING THE ACTUAL SHAPE.

bowl. When the valve in the tank is raised, the lower opening allows a strong jet of water to be thrown upward toward the outlet. This forcibly expels a portion of the contents of the bowl and lowers the water and waste matters into the neck, whence they are ejected by the combined action of the upper and lower flushing-streams. A strong wash descending from the flushing-rim cleanses the bowl thoroughly and afterward refills it to the level of the trap-outlet. The discharge of the closet is almost noiseless, since the lower orifices of the flushing-pipe are submerged.

Considerable space has been given to a description of the most common defects of plumbing fixtures, for the reason that these imperfections are usually the unsuspected source of danger to life and health in houses where the plumbing is most elaborate and costly. Poor material in the drain-pipes and leaky joints are readily recognized perils that may be easier avoided because they are better understood. It may be well, in conclusion, to note a few important points that should be observed in every well-designed system of house-drainage.

The plumbing should be concentrated as much as possible, so

that the various fixtures shall be near one vertical line of soil-pipe extending through the house from basement to roof. This soil-pipe should not be less than four inches in diameter, with an extension above the roof of a size two inches larger, to prevent obstruction by frost. The upper end of this extension should be open, without an attachment of hood, or cowl, or bend, and should not open near a window or ventilator. The soil-pipe should never be connected in any way with a chimney-flue, since downward draughts, when the flue is cold, or when strong winds are blowing, will, in such cases, circulate sewer-air freely through the house.

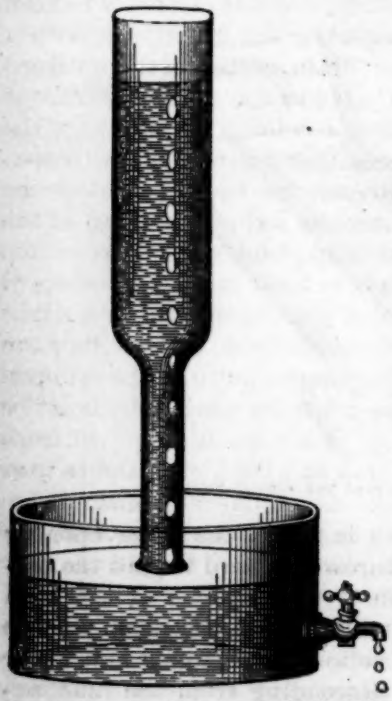

FIG. 14.—INVERTED BOTTLE. To illustrate the principle of an automatic supply to a water-closet trap affected by evaporation or other causes.

The soil-pipe, if of cast-iron, should be of the greatest thickness made for this purpose, as a safeguard against hidden defects in the iron and the danger of splitting at the joints. Soil-pipes and water-pipes should have in all cases as few joints as possible, and these should be made with the greatest care. The well-known Durham system, which employs screw-joints for the connections of long sections of wrought-iron pipes, undoubtedly gives much greater security against leakage than the more common methods of plumbing, which require all joints to be made by calking with lead.

No drain-tiles or earthenware pipes of any kind should be used in the house or under the foundations to convey sewage. Certain local conditions may sometimes require that drains for subsoil water shall be laid within the cellar-walls, and in such cases it is best to have a separate line of drainage entirely independent of the sewer, but, if it is necessary to deliver this water into the main house-drain, the connection must be made at some distance from the house, in such a way as to have a freely ventilated air-space between the two systems of drains, so that there is no opportunity for the foul air from the sewer to enter and circulate through the open-jointed line of earthen tiles beneath the cellar bottom. Almost equal care is necessary when drains for soil-water are laid just without the cellar-walls, since air from the

soil surrounding the foundations is drawn freely into our dwellings, and any pollution of this soil-atmosphere must occasion serious danger.

In a like manner, rain-water conductors are to be cut off from a direct connection with the house drain or sewer. The upper end of conductor-pipes opening near windows may readily convey sewer-air into the house, unless special precautions are taken to guard against it.

It is usual to place a large trap in the main house-drain a short distance outside of the cellar-wall. The object of this is to keep the air of the street-sewer from entering the drain-pipes within the house. But a trap in the main drain obstructs the outward flow of sewage to such an extent as to cause accumulations of filth to collect, which may produce a condition of affairs in the house-drain considerably worse than that existing in the sewer. In ordinary cases it will be safer to omit the trap, and allow the air of the sewer to flow through the main soil-pipe and out at the top above the roof. But there are important exceptions to this general rule. A trap should always be used between a cess-pool and the house draining into it. And when sewers have a slight inclination, with a sluggish flow through them, so that they are unusually foul, it will be better to have traps put into the connecting house-drains. Whenever these traps are used, there must be an inlet provided for the admission of a copious supply of fresh air to the drain-pipes between the trap and the house, and as near to the former as possible. This will cause an almost constant upward flow of air through the main channel of the house drainage system, giving free ventilation to places where impurities may collect.

Space will not allow a more extended consideration of matters of detail. The design and execution of our systems of house-drainage should always be intrusted to some competent sanitary authority, in place of being left to the hap-hazard direction of careless architects and ignorant plumbers. The importance of obtaining absolute security where so much inherent danger exists can not be overestimated. With all the advantages derived from a constant and sure development of the science of sanitation, our houses may be made safe against the entrance of sewer-air. The perils arising from ignorance and neglect are easily eliminated. And, above all, a determined effort should be made to arouse public opinion, so that it shall demand the repeal of objectionable municipal ordinances framed in the interest of corrupt politicians and mercenary tradesmen.

GOURDS AND BOTTLES.

By GRANT ALLEN.

STROLLING, this afternoon, down the street El-Akhdar, where silent Arab women, muffled up to the eyes, gliding noiselessly past, disappeared at my approach, to right and left, down darkling doorways in the narrow alley, I chanced to pass the Moorish shop of my friend the Hadji Omar-ben-Marabet, who, removing his pipe gravely from his mouth for a moment, beckoned me in with his hand to the court-yard of his house to bespeak my favorable inspection of his new stock of rustic, hand-made Kabyle pottery. I followed him through the corridor to the open *oust*, or central hall, and proceeded to look over his latest importations. The Hadji's wares were indeed pretty and curious enough, manufactured in quaint traditional shapes from the coarse yellow clay of the country by the deft-fingered women of the Djurjura Mountains. Two among them took my fancy especially. One was a flattened circular vase or bottle, with a short neck, and two handles at the side, covered with a pretty running arabesque pattern of the kind so common on the Morocco earthenware. The other was a quaint little red gourd-shaped vessel, with two bulges, constricted in the middle, exactly like the ordinary shepherd's gourd that one sees so often hanging from a countryman's girdle on the Roman Campagna or the Provençal hill-sides. After the usual chaffering and higgling of the market, conducted on both sides with unabated ardor for several minutes, my good friend Hadji Omar consented at last to accept for the pair—from me only, he called Allah to witness, as a particular customer—one third of the price he had at first demanded; and I walked off in triumph, at the end of our debate, with my two jars slung proudly in my hand, and my purse lighter by probably not much more than double the real value of my two little purchases. Now, at the wine-shop next door, where a Barbary Jew, in dark-blue turban, jacket, and sash, administers drink, in spite of the Prophet's veto, to thirsty humanity, all and sundry, be it Christian or Moslem, there hung at the lintel a whole string of gourds —the natural fruit, look you, not any spurious fictile imitation— which interested me strangely, because they happened to belong to two separate varieties, the originals and models, as chance would have it, of my two curious Kabyle vases. Struck by the resemblance, I bought one of each, to complete my little illustrative museum of native pottery; and I have them now set up in the horseshoe arch by the window before my eyes as I write, a perpetual reminder of the true origin of all the bottles known

either to barbarous or civilized people. For even that familiar brown glass receptacle out of which we pour Bass's beer at our modern dinner-tables, derives its shape ultimately from the Mediterranean gourd; and every other form of bottle in the known world is equally based, in the last resort, upon some member or other of the gourd family.

I don't believe, indeed, the importance of gourds, as a class, in the history of civilization has ever yet been properly recognized by the annalists of culture. On them, it would seem, with their close congeners the tropical calabashes, the entire art and mystery of pottery ultimately depend. It is possible to trace back almost every vase or other fictile vessel manufactured to-day at Burslem or at Vallauris to this most primitive and simple of all possible water-jars. It behooves us, therefore, in an epoch of pot-hunters, to know something of the nature of this earliest pot, as a moment in the evolution of our existing civilization. A plant on which so ancient and universal an art at last bases itself may well claim some twenty minutes of our scanty leisure in this æsthetic, refined, and pottery-worshiping century.

The gourd, then, to begin at the beginning, is of course a cucumber by family, belonging to the same great group of rapidly growing and large-leaved climbers as the melon, the pumpkin, and the vegetable marrow. All these plants are mere annuals, and they are remarkable among their class for the stature they attain in a single year, for the size of their leaves, and for the bigness of the fruit, in comparison with the short time it takes in growing. Only the sunflower and Indian corn can equal them at all in this last respect. Vegetative energy is the strong point of the gourds. They have a power of growth and a vigor of constitution nowhere surpassed among yearling plants. It was not without reason in the nature of things that the creeper which grew up in a night and overshadowed Jonah should have been figured by the Hebrew allegory as a gourd. No other plant grows so fast, or produces in so short a space of time so luxuriant a canopy of shady foliage.

The true gourds, in fact, have adapted themselves entirely to the climbing habit. This is in itself a half-parasitic mode of existence to which many plants have taken as a bid for life, because it saves them all the trouble and expense of producing a stout and woody stem for their own support. The way the gourds climb is by means of spiral, curled tendrils, which are in reality small abortive stipules or leaf-appendages, specialized for the work of clinging to the external object, be it bough or stem of some other plant, over which the beautiful parasite rapidly spreads itself. The tendrils push themselves out on every side, revolving as they go, till they reach some slender twig or leaf-stalk to which they

can attach themselves. It is curious and interesting to watch them as they grow, and to see how closely their movements simulate intelligent action. The little curled whorls go feeling about on every side for a suitable foothold, groping blindly, as it were, in search of a support, and revolving slowly in wide-sweeping curves, until at last they happen to lay hold with their growing end of a proper object. Once found, they seem to seize it eagerly with their little fingers (for in the gourd the tendrils are branched, not simple), and to wrap it round at once many times over in their tight embrace. It is wonderful how far they will go up out of their way in their groping quest of a proper foothold, and how, when at length they stumble upon it, they will look for all the world as if they had known beforehand exactly when and where to search for it. These actions come far closer to intelligence than most people imagine; they are deliberately performed in responsive answer to external stimuli, and only take place when the right conditions combine to excite them.

Your young gourd, then, once it grows from the seed, begins from the very first to look about for a neighboring bush up which it may climb to reach the sun and air that it could never get at on the ground beneath, or approach by its own unaided efforts. In this respect it is one of the most advanced and highly developed members of its own family. Its humbler ally, the squirting cucumber of the Mediterranean shores (a quaint little creature about which I shall have more to say hereafter), remains to this day a mere lowly trailer, unprovided with tendrils or other means of climbing, and therefore necessarily confined to open, waste places, where alone it can hope to procure its fair share of air and sunlight. In the true cucumber, on the other hand, and the bryony of our English hedges and waysides, there are climbing tendrils, but they are simple and unbranched. In the gourd itself, however, a plant of Indian origin, accustomed to the rough, wild scrub of the tropics, the tendrils are forked, so as to aid the plant in climbing rapidly over the thick and tangled vegetation of its native jungles. The ample leaves then spread themselves out broadly in the full sunshine, mantling their unwilling host with their luscious green, and choking it slowly out by shutting off from its foliage all the life-giving rays and carbon-laden air.

All annuals flower as soon as they have laid by sufficient material for producing their blossoms. The flowers of the gourds, however, like those of their allies the melons and cucumbers, present one very curious peculiarity. In all these plants, the sexes are distinct; and, in most of them, the male and female flowers are borne on totally different plants. The reason for this arrangement is no doubt to be found in the common necessity for cross-

fertilization. And this is how the gourd and cucumber have solved that great *crux* of plant organization:

The male flowers are larger than the female, and consist simply of a funnel-shaped corolla, inclosing a column of yellow stamens. They have no fruit or ovary in the center, nor even the abortive rudiment of such an organ. The female flowers, on the other hand, have no stamens, but the corolla caps a small round berry, the parent or embryo of the future fruit. Its center gives rise to a slender style, forked and feathered at the tip, which is the sensitive surface of the unswollen ovary. Now, when the bee or other fertilizing insect visits a male flower, he dusts himself all over (unconsciously, of course) with the fertilizing pollen. If, on flying away, he next visits another male blossom on the same plant, he only collects still more pollen. But if he happens to flit off to a female flower, he brushes off some of the pollen, as he passes, on to the feathery, sensitive surface protruded by the plant right in his path, on purpose to meet him. In this way, each female blossom makes perfectly certain of due fertilization from a separate organism; and such cross-fertilization, as Darwin has shown, produces in the long run the most fertile seeds, and the strongest, heartiest, and most vigorous seedlings.

Originally, there can be little doubt, the flowers of the gourd family were all hermaphrodite, as those of many among their less developed relations still remain to the present day. But, once upon a time, certain progressive gourds happened accidentally to acquire the habit of producing more or less abortive stamens on certain blossoms; and as these gourds would therefore almost necessarily insure cross-fertilization, and so produce in the long run the finest seedlings, the habit once accidentally set up would be carefully fostered by natural selection, till it grew at last into a confirmed practice of the entire race. All through nature, indeed, we find that the scrubbiest, weediest, and shabbiest species still retain the primitive habit of self-fertilization or in-and-in breeding; but that all the chief places in the hierarchy of life are filled by species which have acquired in one way or another the salutary practice of cross-fertilization, and which thus encourage to the utmost of their power the frequent introduction of fresh blood. The gourds, as a very dominant race, have naturally conformed to the general practice of higher types in this respect; and gardeners find, when they exclude insects from their hot-houses and cucumber-frames, that they have to come to the aid of Nature by artificial means, and to fertilize the blossoms with a camel's-hair pencil.

The flowers of the melon, the cucumber, and the vegetable marrow are bright yellow and almost, if not quite, scentless. Those of the true gourd, on the other hand, with which we are

here chiefly concerned, are white and perfumed. Now, nothing in nature is without a reason; and this change of color in the gourd kind from the ordinary normal hue of its race at large is not without a sufficient purpose either. I don't know whether most people have ever noticed that bell-shaped or tubular white flowers are almost always heavily scented. Examples familiar to everybody occur in the jasmine, the stephanotis, the gardenia, the tuberose, and the large white tobacco so much cultivated of late in garden-borders. It often happens, indeed, that a plant possesses two allied varieties, one of them blue, pink, or yellow, and scentless, while the other is white and deeply perfumed. In these cases, the first kind is a day-flowering plant, while the second opens and spreads abroad its scent in the dusk of evening. One well-known instance exists in England: the red campion or day-flowering lychnis is pink, scentless, and strictly diurnal; while its ally, the white campion, is beautifully perfumed, and opens its flowers at the sunset only. The reason is that the one species is fertilized by day-flying bees or butterflies, and the other by crepuscular or night-flying moths. Now, in the gray dusk no color can so readily be distinguished as pure white; and lest this peculiarity alone should prove insufficient to attract moths to the patch of light among the dark foliage, the added attraction of perfume is thrown in gratis by moth-fertilized plants. Such night-flowering white blossoms never possess the spots or lines or colored marks on the petals, which serve as honey-guides in other plants to lead the bees straight to the laden nectary. In the twilight, variegation or dappling of that sort would be wholly useless.

The blossoms of the gourds, then, are fertilized by moths, attracted to the plant at nightfall by the white corolla and the rich, heavy perfume of the bell-shaped flowers. This perfume is one of a type much affected by æsthetic moths, and not unpleasant to ourselves in the open air, but too cloying for a room, as is the case also with the kindred scent of stephanotis and tuberose. As soon as the flowers have been all fertilized, the male blossoms wither away to nothing; but the small berry underneath the female ones begins to swell out into a big, round fruit with surprising rapidity. Great heat and much sunshine are of course needed in order to produce this startling result with an annual plant; and hence the gourd family consists mostly of luxuriant tropical or subtropical species. Their center of origin would seem to lie in India, where species and individuals are still most numerous. Thence the gourds have spread, with gradual modifications to suit climatic changes, to all the hotter climates of the Old and New Worlds. Some of them have reached as far as Peru and the Cape of Good Hope. But very few of them have spread far northward, because a northern climate is ill-adapted for such large and rap-

idly growing tropical plants. The best known North American example, in the north and east at least, is the pretty little "prickly cucumber," so commonly used in New England and the Middle States as a climbing plant for arbors and trellis-work. A single species alone reaches England, the familiar bryony; and, in this case, the necessary modifications and dwarfing of parts to meet the circumstances of a cold climate are at once apparent. The plant has been forced to become a perennial, and store by nutriment for coming years in its thick and poisonous roots; for the short and treacherous English summer would not suffice for it to bring its fruit to maturity in the first season. The berry has also been fined down from its tropical dimensions to about the size of a haricot-bean, in accordance with the needs of English fruit-eating birds, for a reason which we shall fully examine a little later. If one compares these two tiny northern gourds with the great tropical calabashes, often six feet long and eighteen inches round, one will see at once the amount of degradation undergone by the gourd kind on its northward progress, in adaptation to the needs of a chillier climate.

All the gourd-like fruits are the same in ground-plan, familiar to everybody in cross-section in the case of the unripe cucumber as it appears at the dinner-table. There are always the same three or five rows of flattened seeds, immersed in soft pulp, and surrounded by the fruit with its harder skin, often brilliantly colored with red or yellow. But infinite variations of shape and size are permitted in every direction upon this single original central plan. Nature runs riot in modifications of detail. In order to understand them, we must remember that the gourds, as a family, are berry-bearing plants, dependent in most cases for the dispersion of their seeds on the friendly offices of birds or animals. It is to meet the varying views and tastes of these their animate friends and allies that the different hues, coverings, and pulps of the diverse sorts have all been adopted.

We shall see this better if we look at the one early member of the gourd family which does not seek to attract animals to devour its fruit—the squirting cucumber—and observe the many conspicuous points in which it broadly differs from all its congeners. The squirting cucumber is a scrubby Mediterranean trailer, known to all the world at Nice and Cannes, bearing a long, hairy, and almost prickly fruit, which remains green even when ripe, and is bitter, fetid, and sickening to the senses in all stages. It derives its common name from its curious habit of breaking off short whenever touched, and jumping away from the parent stem, as if alive, while at the same time it squirts out all its seeds, with the surrounding pulp, into its aggressor's face, through the opening left by the broken stem. The squirting cucumber, in short,

if I may venture so to describe it, is the skunk among vegetables. Its object in life, its sole aim and desire, is to deter animals from eating its fruit and seeds; and therefore it makes itself as unpleasant and as inconspicuous as it possibly can. It is green, so that animals may not readily detect its presence among its leaves; it is spine-clad, so that they may not attack it with their tender noses; it is nasty to the taste and disagreeable to the smell, so that they may avoid its neighborhood when once they have learned to know its personal peculiarities. If a goat or a donkey, wandering among the scrub, chances to touch the long, trailing branches, the cucumber squirts out its juice in his eyes, and at the same time sows its seeds all round on a spot where no hostile creature is likely to interfere with them. We have here in a very extreme form a specimen of that rare type of succulent fruit which does not lay itself out at all to attract the attention of friendly animals, but, on the contrary, endeavors energetically to repel them.

The mass of the gourd-kind, however, pursue the exactly opposite tactics. They have learned by experience to imitate rather a policy of conciliation, and to turn the birds, quadrupeds, and fruit-eating animals generally in their environment from deadly foes into friendly disseminators. For this purpose, their fruits, when ripe and fit for seeding, become red, yellow, pink, or orange, though they only assume these brilliant hues at the exact moment when the seeds are ready to be severed from the parent stem and dispersed for germination. Till that time, they remain green and sour, or at least tasteless. The seeds in these cases are surrounded by a soft, sweet pulp, especially noticeable in the melon and the watermelon; and this pulp the plant gives in, so to speak, as an inducement to animals to disseminate its seeds over the surrounding country. It has learned organically the value of rotation of crops. It desires fresh soil in which to expand. The actual seeds themselves, however, are not sweet; they are inclosed in a hard and somewhat horny or leathery shell; and they are seldom eaten and still seldomer digested by birds or animals, owing to their tough and slippery surfaces. We have here, then, the very same inducements of food, sweetness, perfume, and color expended by the plant upon its fruit for the sake of its seeds that we saw before expended upon the flower for the sake of obtaining cross-fertilization by the aid of insects.

At the same time, it is interesting to note that almost all the gourd family possess in some part or other of their economy certain bitter, nauseating, medicinal principles, expressly intended to deter animals from meddling with or eating them. But these bitter principles are variously distributed in the leaves, stems, stock, or fruit, according to the special type of dangers to which the par-

ticular plant is specially exposed. The red berries of our English bryony are eaten by birds, who aid, of course, in disseminating the seeds; but the big and swollen root, known to French herbalists as the *navet du diable*, in which the plant stores all its accumulated material for next year's growth, is strenuously protected from the attacks of rabbits, pigs, and other grubbing animals by an intensely bitter and poisonous principle which chemists call bryonine. Colocynth, again—the amorous colocynth—is a plant closely allied to the melon and cucumber; but in this case the intensely bitter and poisonous essence (the "uncompounded pills" of the poet) is diffused in the fruit itself, which, like that of the squirting cucumber, desires to repel rather than to entice the attentions of animals. In the edible cucumber, once more, which prefers to be eaten, the bitter principle is collected at the stalk-end of the unripe fruit, as well as generally in the outer rind, thus serving to prevent attacks in the early stages of growth, or unauthorized grubbing into the soft pulp by useless insects. I suppose I need hardly remind even the non-agricultural mind in these days of villa-gardening that the ripe cucumber is bright yellow, smooth, and faintly sweetish; on our tables it always appears in its unripe stage, when it is green, hard, and covered externally with rough excrescences, intended to repel the attacks of enemies. In the early gherkin state it is even prickly.

The fruit of the actual bottle-gourd itself is intermediate in size between the great tropical calabash and the little bryony-berries of our northern hedge-rows. Its one noteworthy peculiarity lies in its hard, coriaceous, and shining rind, far more woody in character than even that of its near allies the pumpkins and the calabashes. This peculiarity, again, is not without a meaning in the history of the race: it points back with no uncertain finger (why should gourds be denied fingers?) to the subtropical origin of the gourd species. For the bottle-gourd itself, to employ the language most frequently applied to our Aryan brother, is a native of India, though it has long been cultivated for the sake of its fruits round the whole Mediterranean. Now, it is a noticeable fact in the philosophy of fruits that most fruits of northern climates, like the strawberry, raspberry, blackberry, and currant, can be picked off the bush, tree, or vine, and popped at once into the mouth without any preparation; but almost all tropical fruits, like the orange, pineapple, mango, and banana, require a plate with a knife and fork to eat them with; in other words, they can only be eaten after we have stripped off a hard or nauseous rind.

Why this difference? Well, it has reference clearly to the kind of animals by which the seeds of each are oftenest disseminated in the native condition. Northern fruits, in short, are mainly eaten by small birds, which swallow them whole, but

never digest the hard, knobby seeds, so conspicuous in the blackberry, the currant, and the grape. Southern fruits, on the contrary, are mainly eaten by parrots, monkeys, and other large fruit-feeders, for whose attraction the plants specially lay themselves out. Hence the southern types desire to keep off unauthorized small intruders, which would merely pick holes in their pulp without doing any real good to the plant, as wasps do with our northern peaches. For this purpose, natural selection has favored in their case the development of various abstruse devices for keeping off the smaller birds and animals. Sometimes, as with the orange, lemon, and citron, the outer rind is bitter and nasty; sometimes, as with the cashew, it is violently pungent, acrid, and irritating; sometimes, as with the pomegranate, it is merely hard, stiff, and leathery. But, in all instances alike, it is meant to repel by every means in the plant's power the small intruder. Monkeys and parrots, however, the friends of the species, do not mind these slight outer defenses; they strip them off easily with hand or beak, and reach the sweet pulp within, duly intended by the grateful tree for their edification. On the other hand, the actual seed itself in tropical fruits is always thoroughly well protected against their teeth or bills, either by a very hard stone, as in the olive, date, and mango, or by intense bitterness, as in the orange and lemon.

It is to this specially defended tropical type of fruits that the true bottle-gourd essentially belongs. Our little English bryony has a mere northern bird-berry, round, and red, and soft, and almost rindless; it has adapted itself in this matter to the small ways of robins and finches. But the gourd has a hard and forbidding rind; it fastens itself up in a firm covering; it lays itself out with all its soul for the larger fruit-eaters of tropical forests. Not, indeed, that in its raw ripe state the gourd is by any means so dry and hard as in the arid form which we see in southern wine-shops. The method of preparing gourds for use as bottles is, indeed, a sufficiently lengthy one. You pick your fruit and hang it up to dry, not in the sun, but under the shade of the roof, for a whole year before it is fit for boring. As soon as it has hardened evenly all over, you cut a round hole at the stalk-end (at least in the common double-bulging form employed as a flask by southern shepherds) and rattle out the dry seeds and pulp, which easily come out of themselves through the opening. The remaining husk is hard enough and thick enough to bear carving. I have several gourds in my little collection thus carved in deep relief with Moorish patterns, including one which bears on its face, four times repeated, a text from the Koran.

Gourds, calabashes, and the shells of cocoanuts, together with human skulls and the horns of cattle, sheep, and antelopes, seem

to have formed the earliest natural objects employed as vessels by primitive humanity. But of all these the gourd, by its singular variety of shape, best lent itself to the greatest and most varied uses. Besides the common double-bulging form, constricted in the middle, with the little bulb above and the big one below, so frequent as a water-bottle, you can get gourds in an immense number of other types, globular, compressed, bowl-like, or flask-shaped. A Corsican model, which lies before me this moment as I write, has a flattened circular form from back to front, the back being the side next the stalk, and the front the side where the corolla has fallen off, leaving a little umbilicus or knob to mark its place in the very center. This form is ingeniously turned by the Corsicans into a very neat sort of flask or bottle for the girdle by cutting holes in the narrow side and fastening two handles for suspension at a graceful point half-way between the mouth and the middle line of the circle. The pretty vessel thus obtained is the model on which thousands of exquisite vases have long been turned out in ancient Etruria and at modern Vallauris.

The commonest shape of all, however, is the Syrian gourd with a round bulb, ending toward the stalk in a long neck, and capable, when filled with wine or water, of standing securely on its own basis by means of the slight depression at the umbilicus. This is, indeed, the original parent from which almost all bottles, *carafes*, and decanters, all the world over, have ultimately descended. The terra-cotta forms used as water-bottles, with a round bulb and long neck, most closely resemble their original to the present day, as the Japanese vases of two or three bulbs, successively constricted and growing larger from top to bottom, most closely resemble the double-bulging variety.

The reason why gourds are so manifold in shape is twofold. It is partly because they are a naturally plastic species, constantly giving rise to various divergent forms, like their neighbors the cucumbers; which divergent forms have, of course, been seized upon and still further developed for his own use by gourd-using man. But it is partly, also, because gourds, while growing, can be made to assume almost any desired shape or curve by tying string or wire round their rind. Primitive man early discovered this simple method of manufacture. I have seen gourds which in this manner have been twisted into the semblance of powder-horns or wallets, and others which have been induced to ring themselves round half a dozen times over till they look almost like beads on a necklace.

Early man, no doubt, used his gourd as a gourd alone. But as time went on he began at last, apparently, to employ it as a model for pottery also. In all probability his earliest lessons in the fictile art were purely accidental. It is a common trick with savages to

put water to warm on the camp-fire in a calabash or gourd with wet clay smeared over the bottom to keep it from burning. Wherever the clay thus employed was fine enough to form a mold and bake hard in shape, it would cling to the gourd, and be used time and again in the same way without renewal, till at last it came to be regarded almost as a component part of the compound vessel. Traces of this stage in the evolution of pottery still exist in various outlying corners of the world. Savages have been noted who smear their dishes with clay; and bowls may be found in various museums which still contain more or less intact the relics of the natural object on which they were modeled. In one case the thing imbedded in the clay bowl is a human skull, presumably an enemy's.

In most cases, however, the inner gourd or calabash, in proportion as it was well coated up to the very top with a good protective layer of clay, would tend to get burned out by the heat of the fire in the course of time; until at last the idea would arise that the natural form was nothing more than a mere mold or model, and that the earthenware dish which grew up around it was the substantive vessel. As soon as this stage of pot-making was arrived at, the process of firing would become deliberate, instead of accidental, and the vessel would only be considered complete as soon as it had been subjected to a great heat which would effectually burn out the gourd or calabash imbedded in the center. But the close similarity of early fictile forms all the world over, and their obvious likeness to the same simple, natural types, combine to show us that the art of pottery had everywhere the same easy origin, and that it was everywhere based on the same primitive unmanufactured vessels.

Three main forms of pottery, and later of glass-ware, may be safely held to take their origin from the bottle-gourd alone. The first is the double or treble-bulbed vase, so common a type in Japanese and Oriental pottery. This is the most distinctively gourd-like of all, and it has given rise indirectly to endless variations. The second is the flat, circular vase with two lateral handles—the *diota*—always showing in early specimens its gourd origin by the nature of its ornamentation, which radiates (as is well exhibited by some of my Morocco specimens) from the umbilicus or calyx-scar in the center of the fruit. The third is the clay water-bottle or *carafe*, with round bulb below and tall neck above, which gives rise in turn to the vast majority of modern vases, vessels, and bottles. Even the common beer-bottle, with the "kink" or "kirck" at the bottom, affiliates itself ultimately upon this last-named form, being derived in the last resort from those long-necked gourds which could stand firmly on their own basis, owing to a slight re-entrant depression about the umbilicus. The bowl or basin, on the other

hand, owes its shape rather to the gourd or calabash cut in two transversely, and used as an open receptacle for liquids and powders. Of such bowls I have one or two excellent savage specimens. To this type may at last be traced, I believe, the tea-cup, the coffee-cup, the mug, and perhaps also the tumbler.

I may add that, in simple and early types of pottery, the ornamentation is always based on the natural forms suggested by the first or other primitive model. The decorations were first copied, I believe, from the ornamentation carved or worked on the natural form, except where they arose from the marks of thongs or other suspenders used in the firing. Now, in the gourd we have, so to speak, three natural elements of ornamentation to which all decorative adjuncts, if any, must necessarily adapt themselves: First, there is the stalk cut off to form the mouth in my first and third types, but retained as a central scar or knob, the main focus of the whole, in the second or diotic form so common in Corsica; secondly, there is what I have ventured here to call the umbilicus —the mark left by the faded calyx and corolla in the center of the fruit, retained as a central point of the vessel in all three forms; and, thirdly, there are the lines in the grain of the gourd which radiate like meridians from either pole, running from the stem-scar right round the equator to the umbilicus. Whoever tries to decorate a real gourd, either by carving or painting, will find himself practically compelled to fall in with the natural lines thus inevitably laid down for him; he must obey the laws of his prime material. All gourds actually decorated, however rudely, in simple and *naïve* societies are so adorned. Hence, in the first and third forms, the decoration runs up and down the sides of the bottle, or in transverse bars and longitudinal lines; while in the second or flat, circular vase type it runs always in concentric rings round a point in the middle.

Now, this pretty Kabyle ware, which formed the original text for my present sermon, is pottery of a very antique and *naïve* type—the last relic, in fact, of ancient Phœnician art. The Phœnicians brought these ideas with them to Carthage, and the Crathaginians diffused them among the aboriginal mountaineers of the Atlas range, whose lineal descendants are the Kabyles of the Djurjura in our own day. That simple ware, with its yellow groundwork and its dichromatic ornamentation in russet-brown and black (the one ochre, the other peroxide of manganese), has been manufactured ever since in the uplands of the Atlas by the Moslemized grandsons of the Christianized Mauritanians. In tone and color it recalls somewhat the earliest Greek and Etruscan vases: but the law of Islam, of course, prevents the introduction of human or animal figures, so the ornamentation now consists entirely of geometrical and arabesque designs, accommodated to

the necessary natural lines of their gourd originals. Each village has its own distinctive patterns. I have a small collection of native Kabyle and Morocco pottery, and in every piece without exception one can see at once the particular sort of gourd—double, single, or flat-faced—on which each individual vase must be finally affiliated. And, when once one has learned to know and recognize these central types, the character of the ornamentation on more advanced keramic products of other nations often enables one to guess correctly from what original natural form the particular piece in question is ultimately descended. I believe it would be possible so to arrange all the keramic products in a great museum, along a series of divergent radial lines from certain fixed centers, that the common origin of all from each special sort of gourd or calabash would become immediately obvious to the most casual observer.

DARWINISM AND THE CHRISTIAN FAITH.

III.

WE come now to that which most people feel to be the real difficulty in the way of accepting Darwinism. No well-instructed churchman supposes that the faith of Christ stands or falls with the theory of special creations, or that the existence of God is less certain because we have learned that the witness of conscience is necessary to interpret the witness of Nature, and that physical science by itself can tell us less than we thought about the personality and the love of God.

4. But Darwinism means a great deal more than the substitution of derivation for special creation, or of the new teleology for the old argument from design. It means a new view of man, and his place in creation. Darwin foresaw this from the first, and in the "Origin of Species" asserted his belief that "much light will be thrown on the origin of man and his history."* Now, if this had only meant a chemical analysis of "the dust of the ground" out of which man was formed, if, like Matthew Henry, Darwin had assured us—on grounds for which, indeed, no evidence is given—that the dust was "not gold dust, powder of pearl, diamond dust, but common dust: dust of the ground"; "not dry dust, but dust wetted with the mist which went up from the earth," it is clear religion would have felt that it had lost as little as science would have gained. But Darwin's theory connected man with the higher *vertebrata* by analogies as strong as those which made other species descendants from a common stock. This was the secret of the opposition to the "Origin of Species."

* P. 428.

It was not so much what was stated, as the obvious implications of the doctrine, which men shrank from. Darwin, who had nothing of the defiant arrogance of some who speak in his name, was even accused of dishonesty in not clearly stating at the outset the bearing of the doctrine on man. And his volume on "The Descent of Man" was his answer to the charge. But his letters show how fully he realized the consequences of his theory from the first:

> I am deeply convinced [he wrote to Lyell, while revising the proof-sheets of the "Origin"] that it is absolutely necessary to go the whole vast length, or stick to the creation of each separate species.* . . . I can see no possible means of drawing the line and saying, Here you must stop.† . . . I believe man is in the same predicament with other animals. It is, in fact, impossible to doubt it.‡

For the scientific acceptance of the theory, as Darwin says, "*ce n'est que le premier pas qui coûte,*"* but for people generally, who judge a theory by its consequences, not on its evidence, it is, as he says of Carpenter, "the last mouthful that chokes."‖ Of course, as he admits, it is open to every one to believe that man appeared by a separate miracle,^ but to hold the doctrine of special creation here and here only is to ignore the arguments which, *ex hypothesi*, carried conviction everywhere else.

It was on this point that Darwin and Wallace parted company, though the divergence is commonly represented as far greater than it was. Wallace admitted the evolution of man out of a lower form, but contends, and this was what he calls his "heresy," that natural selection would have only given man a brain a little superior to that of an ape, whereas it is greatly superior. He therefore contrasts "man" with the "unaided productions" of Nature, and argues that, as in artificial selection, man supervenes and uses the law of natural selection to produce a desired result, so "a higher intelligence" may have supervened, and used the law of natural selection to produce man. Whether from the scientific side this is rightly called a "heresy" or not it is not necessary to decide; but certainly, from the religious side, it has a strangely unorthodox look. If, as a Christian believes, the "higher intelligence" who used these laws for the creation of man was the same God who worked in and by these same laws in creating the lower forms of life, Mr. Wallace's distinction, as a distinction of cause, disappears; and if it was not the same God, we contradict the first article of the Creed. Whatever be the line which Christianity draws between man and the rest of the visible creation, it certainly does not claim man as the work of God, and leave the rest to "unaided Nature."

We have then to face the question, If it be true that man, "as

* "Life and Letters," i, p. 519. † i, p. 526. ‡ ii, p. 59.
* [It is only the first step that costs.] ii, p. 30. ‖ ii, p. 35. ^ ii, p. 58.

far as his corporeal frame is concerned,"* is created, as other species were, by evolution from lower forms; if he was not, as we have been accustomed to think, an independent creation, but related through his whole bodily structure with "the beasts that perish"; if he was not an absolutely new departure, but the last term in a progressive series—how does this new view affect our Christian faith?

We might have been ready to answer, It no more touches the Christian view of human nature than a scientific proof, if it had been possible, that our blessed Lord was very man would affect the truth of his divinity. And the analogy is a very close one. It is not heresy to assert that Christ is Ἄνθρωπος, but that he is ψιλὸς ἄνθρωπος, man and nothing more. Similarly, say what we will of the affinities of man's physical nature, it is only when we deny that he is anything more that we really degrade him. As Bacon somewhere puts it—

> They that deny a God destroy man's nobility; for certainly man is of kin to the beasts by his body; and if he be not of kin to God by his spirit, he is an ignoble creature.

Unfortunately, Christian apologists have missed an important distinction. They have not seen that their controversy with a Darwinian agnostic is a controversy with his agnosticism, not with his Darwinism; with his limitation of all knowledge to the facts of sense, not with any doctrine he may scientifically prove as to the interrelations of the facts observed.

We are constantly told that Darwinism is degrading, that it is unworthy of the dignity of man, that it is a "gospel of dirt." If such a charge had come from a representative of those nations which held the descent of man from gods or demigods, it would have been intelligible enough, but it sounds strange in the mouth of those who believe that "the Lord God formed man of the dust of the ground." Indeed, what in Darwinism is called a "gospel of dirt," appears in the Bible as a "gospel of grace." We naturally, as Kingsley says, seek—

> To set up some "dignity of human nature," some innate superiority to the animals, on which we may pride ourselves as our own possession, and not return thanks with fear and trembling for it as the special gift of Almighty God.†

But the inspired writers "revel in self-depreciation" that they may the more exalt the love and condescension of God. The moral, as distinct from the scientific, teaching of the Bible can not be mistaken in this matter. Man made in the image of God, inbreathed with the breath of life, is formed of the dust of the ground. God's method is always to choose "the base things of the world and things which are despised," and use them for his

* Darwin, ii, p. 140.

† "Prose Idylls," p. 22.

purposes. The chosen people traced their descent from "a Syrian ready to perish." They were the "fewest of all people," and constantly reminded of their origin. "Remember that thou wast a bond-servant." "Look unto the rocks whence ye are hewn, and to the hole of the pit whence ye are digged." And yet they were what they were, the destined repository of the oracles of God, and the religious teachers of the world. The Bible at least gives no color to a view which refuses a degraded origin for man.

But Darwinism, dealing with man, as it is bound to do, simply from the side of his animal and corporeal nature, has done something to give man his true place in the physical universe. It has, by the application of its own methods and its own tests, recognized him as the roof and crown of all things visible. And by so doing it has rendered any form of Nature-worship henceforth impossible. The highest, or the least degrading of these, was the worship of the sun. When Anaxagoras ventured the speculation that the great god Helios was a mass of molten metal, he was condemned as a heretic. Science has trodden in his footsteps, and we know now that the sun is a very large ball of solid and gaseous matter, in a state of fierce incandescence, and supported by involuntary contributions. It has been "found out," as completely as the Boxley rood, when people were shown its works—

> No man [as the Duke of Argyll says] can worship a ball of fire, however big; nor can he feel grateful to it, nor love it, nor adore it, even though its beams be to him the very light of life. Neither in it, nor in the mere physical forces of which it is the center, can we see anything approaching to the rank and dignity of even the humblest human heart.*

Nor can we any longer worship organic Nature. For we are ourselves, if Darwinism is true, the last term in the series. If man must have a visible god, he must henceforth worship himself or something lower. In Genesis he is made lord of the visible world, to have dominion over the fish of the sea, and the fowl of the air, and every living thing that moveth upon the earth. What Genesis speaks of as the will of God, Darwinism reads in Nature as a fact:

> Man [says Darwin] in the rudest state in which he now exists is the most dominant animal that has ever appeared on this earth. He has spread more widely than any other highly organized form, and all others have yielded before him.†

It is not true, then, that Darwinism degrades man, for in tracing his descent it chronicles his rise from the lowest origin to the highest order of being of which science has any knowledge.

And what about the soul? If man, in his animal nature, was evolved from lower creatures, when did God "breathe into his

* "Unity of Nature," p. 309. † "Descent of Man," p. 48.

nostrils the breath of life"? Was the soul, too, created by evolution, or was that at least a "special creation"? We are here, be it observed, going beyond the range of our subject, which was the relation of Darwinism to the Christian faith, and passing into a region where neither science nor religion has spoken. Dr. Pusey says "theology does not hold transformist theories excluded by Holy Scripture, so that they spare the soul of man." But science spares the soul of man, just as it spares original creation, because it can not have any knowledge of either. It can deny both. What is there that man can not deny? It may even cover its dogmatic denial by a semblance of reason with the help of the major premise: "What science can not know can not be known." From this, no doubt, the conclusion follows with logical necessity. But we answer with *negatur maior*. With regard, however, to the question of the origin of the soul, as a theological problem, it is perhaps easier to say what is not true than what is. The soul can not be a "special" creation whether in Adam or in his children. There is no "species" of soul. We may call it, if we will, an "individual" creation; but is not all creation individual creation from the religious point of view? And if so, it is a phrase which does not help us.

We can, however, *explain* the difficulty in precisely the same way in which science explains a law—namely, "by substituting one mystery for another."* We may say that there is no actual or conceivable difficulty in the creation of the soul of Adam which does not recur in the case of every child born into the world. Is its soul inherited, like its bodily organism, or is it added to the body? The instincts of Christianity, rather than any formal decision, have throughout been against traducianism, or the inheritance of the soul. Creationism, or the *infusio animæ*, on the other hand, guards a truth which traducianism loses. But in spite of all the authority which can be claimed for it, it sounds crude and strange, to our ways of thinking. The very word *infusio*, and, in a lesser degree, the barbarous word "insufflation," suggest that the soul is a *thing* which at a definite though unknown moment is put into the body "like a passenger in a boat," as Aristotle has it. If so, the body before the advent of the soul was not in any real sense human. For "the reasonable soul" is as essential to true humanity as the "flesh." And if the analogy suggested in the Athanasian Creed justifies us in appealing to that greater mystery, on which Christian thought, in defense of the faith, has been compelled to speculate and define, we have to remember that it is heresy to assert that "that Holy Thing," which in the fullness of time was to be born of the Vir-

* Mill, "Logic," i, p. 527.

gin, *became* at any moment the Word of God. In the history of the individual, so far as his physical structure is concerned, science can trace each step from the microscopic cellular germ to the fully developed man. If we believe that man as man is an immortal soul, though we can not say when he became so, or that, strictly speaking, he ever did *become* so, we need not be surprised to meet the difficulty again in the evolution of man from lower forms.*

In both cases man is what he is, whatever he came from. We do not say a man is not rich because we have found out how he made his fortune. We do not say the eye can not see because we can trace it back to a speck of pigment sensitive to light. Whether God formed man literally "from the dust of the ground," or raised him by progressive selection to what he is; whether, in scientific language, man rose to manhood "by the final arbitrament of the battle for life";† or whether, as Mr. Wallace thinks, there is a certain amount of "unearned increment" to be accounted for, man is still man, "the glory and the scandal of the universe." Darwin, feeling "the extreme difficulty, or rather impossibility," of conceiving the universe as not being the work of "a First Cause having an intelligent mind in some degree analogous to that of man,"‡ is driven back into agnosticism by the question, "Can the mind of man, which has, as I fully believe, been developed from a mind as low as that possessed by the lowest animals, be trusted when it draws such grand conclusions?"* Yet when Darwin, in all the wealth of his scientific experience, and all the strength of his disciplined reason, gives us his matured judgment on the processes of Nature, who would dream of saying, "How can I trust the conclusions of a man who was once a baby"? We trust him for what he *is*, and not for what he *was*. And man is man, whatever he came from. And what is man?—

> "Distinguished link in being's endless chain!
> Midway from nothing to the Deity!
> A beam ethereal sullied and absorpt!
> Though sullied and dishonored, still divine!
> Dim miniature of greatness absolute!
> An heir of glory! a frail child of dust!
> Helpless immortal! insect infinite!
> A worm! a God!"‖

What a piece of work is man [says Hamlet]. In action, how like an angel; in apprehension how like a god! the beauty of the world! the paragon of animals! And yet, to me, what is this quintessence of dust?^

Man is a part of Nature [it has been said], and no artificial definitions can separate him from it. And yet in another sense it is true that man is above Nature—

* Cf. "Origin," p. 412.
* Ibid.
† "Descent of Man," p. 48.
‡ "Life and Letters," i, p. 282.
‖ "Night Thoughts," i.
^ Act ii, scene ii.

outside of it; and in this aspect he is the very type and image of the supernatural.*

By Nature we understand all visible things, including man so far as he can be observed by the naked eye or the microscope—his morphology, his physiology, his histological development. But for a Christian this does not exhaust human nature. For him visible Nature is the segment of a circle, "we see but in part." And the visible is not coextensive with the known. Rather the ultimate explanation of "the things which are seen" is to be sought in "the things which are not seen." There are forces which refuse to be measured by "foot-pounds," facts which forever must escape the microscope, realities which cast no bands upon the spectrum field, a life which the scalpel can neither discover nor destroy. A Christian believes with Mr. Darwin "that man in the distant future will be a far more perfect creature than he now is," and finds it "an intolerable thought that he and all other sentient beings are doomed to complete annihilation after such long-continued slow progress";† but he holds it in a different way and on different grounds. And, believing in the truth of man's divine nature, he can watch without anxiety, not without interest and gratitude, the work of those who are showing us man's place in the physical world. Darwin tells us that, as he lay on the grass on an April morning at Moor Park, amid the joy of opening spring-tide, he "did not care one penny how any of the beasts or birds had been formed."‡ Amid the supreme realities of the moral and spiritual world, or in the devotional study of the Word of God, it becomes a matter of relative unimportance to a Christian whether he is to trace his pedigree back directly or indirectly to the dust. For it is God's world after all. We believe in the resurrection of the body as well as the immortality of the soul. That which is material is not "common or unclean":

What we are [says Kingsley], we are by the grace of God. . . . Saint Francis called the birds his brothers. Whether he was correct, either theologically or zoölogically, he was plainly free from that fear of being mistaken for an ape, which haunts so many in these modern times. Perfectly sure that he himself was a spiritual being, he thought it at least possible that birds might be spiritual beings likewise, incarnate like himself in mortal flesh; and saw no degradation to the dignity of human nature in claiming kindred lovingly with creatures so beautiful, so wonderful, who (as he fancied in his old-fashioned way) praised God in the forest, even as angels did in heaven.*

With regard to all this higher side of man's nature, Mr. Darwin was an agnostic. He uses the word more than once of himself, and yet, with that transparent honesty which characterizes all that he did, he admits the difficulty as well as the unsatisfactoriness

* "Unity of Nature," p. 308. † i, p. 282. ‡ i, p. 471. * "Prose Idylls," pp. 24, 25.

of his position. There was a time when men dared to say that because the presence of sin veils the knowledge of God, therefore they who do not accept Christianity in a Christian country must be guilty of secret, if not open, sin. That phase, thank God, has passed. And then—that men might have a theory—they talked of intellectual pride. Intellectual pride, which is self-assertion, no doubt obscures the vision of God. It is as much a rejection of God as a sinful life is. But dare any one say that loss of faith or the inability to receive it must spring from one of these two causes—immorality or intellectual pride? We believe it is impossible to read Darwin's "Life and Letters" without noticing as the most striking characteristics of Darwin's mind his intense modesty, his self-forgetfulness, his shrinking from popularity or applause, while gladly welcoming the testimony of those who were competent to judge of the truth of his work, his devotion to truth as shown by the weight he gave to unfavorable facts, his humility, his simplicity, his reverence. How could such a lovable nature, we are tempted to ask, have rejected Christianity? or, to put it differently, how could Christianity have failed to make good its appeal to such a nature as this?

In the whole record there is nothing so intensely interesting as Darwin's account of his religious opinions and the steps by which he became an agnostic. What was his religious history? His mother was a Unitarian, his father he describes as "a free-thinker in religious matters," though nominally belonging to the Church of England. Darwin himself was christened and was meant to belong to the Church, but he was sent to a day-school kept by the Unitarian minister. His mother attended the Unitarian chapel and took her sons with her. She died when he was eight years old, and after that he seems to have gone to church, and later on we hear of his intention of "going into the Church"* —an intention which was not abandoned till the Beagle voyage. His view of the ministry is incidentally given in a letter from Lima in 1835: "To a person fit to take the office the life of a clergyman is a type of all that is respectable and happy."† During all this period he "had not thought much about the existence of a personal God."‡ He had read Paley, but had taken Paley's premises "on trust,"* so that even his Unitarianism, which, as he tells us, his grandfather spoke of as "a feather-bed for a falling Christian," was hardly enough to break the fall. Under such conditions we are not surprised to hear that the intention to be a clergyman "died a natural death."‖ That idea abandoned, the two props on which his religion rested—Paley's "Natural Theology" and Pearson "On the Creed"—gradually gave way. The Paleyan argument disappeared with the abandonment of special

* i, p. 146. † i, p. 234. ‡ i, p. 278. * i, p. 41. ‖ i, p. 39.

creation; the Old Testament, from which Pearson started, seemed "no more to be trusted than the sacred books of the Hindoos."* "Disbelief crept over me at a very slow rate, but was at last complete. The rate was so slow that I felt no distress."† One of his difficulties is worth noticing as showing how little he had brought religious truth under that great conception of growth which dominated all his physical inquiries. It seemed to him "incredible" that, if God were now to make a revelation to the Hindoos, he would permit it to be connected with the belief in Vishnu, Siva, etc., as Christianity is connected with the Old Testament. Why? except for the very reason that makes it "incredible" that man should be evolved directly from a fish, and not "incredible" that he should be evolved from the higher vertebrates. He has organic relations with both, but these relations are not such as to make it indifferent from which he is derived.

It was not religion alone, however, that "died a natural death" in Darwin's case. It is almost pathetic to read his account of the way in which he fell out of correspondence with poetry and painting. Up to thirty or beyond he delighted in both. Gradually they ceased to interest him, and finally they became positively distasteful:

> I can not endure to read a line of poetry: I have tried lately to read Shakespeare, and found it so intolerably dull that it nauseated me. I have almost lost my taste for pictures or music. . . . My mind seems to have become a kind of machine for grinding general laws out of large collections of facts. But why this should have caused the atrophy of that part of the brain alone on which the higher tastes depend, I can not conceive. . . . If I had to live my life again, I would have made a rule to read some poetry and listen to some music at least once a week; for perhaps the parts of my brain now atrophied would thus have been kept active through use.‡ . . . It is an accursed evil to a man [he writes to Hooker in 1858] to become so absorbed in any subject as I am in mine.*

We shall not, we trust, be accused either of want of sympathy or want of charity, if, in the light of what Darwin has told us of his religious history, we sum it up in the words *the atrophy of faith*. That which Bacon sets first among the "Idola Specûs," the tendency to draw everything round to the predominant pursuit, shows itself in as many forms as there are absorbing studies. A theologian or moralist rarely appreciates the strength of scientific evidence: a scientific man underrates the value of moral and spiritual forces. It is unfortunately always easy to discredit or ignore facts which are not *in pari materiâ* with those which lie nearest to our heart, or to offer, in terms of our own special study, an explanation which only explains the facts away. So the theologian will pooh-pooh scientific discoveries which do not readily and at once fall under his own categories of thought; and the sci-

* i, p. 277. † i, p. 278. ‡ i, pp. 81, 82. * i, p. 495.

entific specialist will blandly put aside religion, because he can not without trouble relate it with what he can touch and taste and handle. To relate truths which belong to different orders plainly requires a greater effort than to relate those which belong to the same. Yet if the effort be not made, the predominant study may still advance, but at a real, perhaps a fatal, cost. The atrophy of faith is commoner than atrophy elsewhere. For men have come to think that while they must devote a lifetime to science, or philosophy, or art, or literature, they can pick up their religion as they go. And the result is, that religion becomes like a tender exotic in their lives, and in their struggle for existence "the thorns spring up and choke it." Agnosticism is often an *ex post facto*, though honest, justification in theory for a religious atrophy which has already taken place in fact, just as men deceive themselves and appeal to "other-worldliness" to cover the neglect of daily duties. Christianity makes faith the Christian's *work*. It knows no short cut to spiritual truth, only the royal road of individual search and personal effort. But there are agnostics like Darwin, and there are agnostics whose agnosticism is a thin disguise for plump self-satisfaction. There are evolutionists like Darwin, who can not see their way to Christ; there are also evolutionists like the great American botanist, just dead, who speaks of himself as—

> One who is scientifically, and in his own fashion, a Darwinian, philosophically a convinced theist, and religiously an accepter of the "Creed commonly called the Nicene" as the expression of the Christian faith.

POSTSCRIPT.

Among the many difficulties which in the preceding articles we have not touched, there are two which will probably be present to the minds of many. Without attempting to discuss them, we may state them, and suggest the lines on which, as it seems to us, they should be dealt with.

1. It may be said, "Then you are prepared to give up Genesis?" To which it may be answered, "*Yes*," if by "giving up Genesis" you mean refusing to claim for it what it never claims for itself—that it is a prophetic anticipation of nineteenth-century science, and a revealed short cut to Darwinism. We can not sympathize with those "reconcilers" who would read between the lines of the Mosaic history a meaning which, if had been stated in plain words, would have put an infinitely greater strain on the faith of those for whom it was written than even its verbal accuracy would put on ours in the present day.

2. Then, it may be asked, "How about the fall? Is that an allegory, or a metaphorical name for a step forward in evolution?" We answer briefly: The fall implies a change, and a

change for the worse, in the relation of man as "a living soul" to his Creator—God. Positive science—and Darwinism is in every way bound by the limits of positive science—will neither help nor hinder us in discussing the relation between two terms, both of which are outside its range.

In a word, we are as little prepared to consult Genesis on the order of the paleontological series as to ask the high-priests of modern science to solve for us the difficulties of our moral and spiritual life.—*The Guardian.*

THE TEACHING OF PSYCHOLOGY.

By M. PAUL JANET.

IN giving the name of Experimental and Comparative Psychology to the chair into which it has transformed its ancient chair of the Law of Nature and of Nations, the College of France has sought to give it a title broad and comprehensive enough to accommodate itself to all contingencies. To have called it physiological psychology would have made physiology too prominent, and the chair might then eventually have become a mere annex of that science. Physiologists have done much, but they have not done everything, for experimental psychology. An intelligent magistrate who has thoroughly studied the moral and mental state of criminals; a philosopher versed in ethnological or in animal psychology; a pedagogue who has observed human faculties from an educational point of view; a pure psychologist, acquainted to the bottom with all parts of the science, but capable of including them in a single philosophical synthesis—might all compete for such a chair, which would not then be the exclusive domain of any one specialty. The real name for this science would be objective psychology, if that term were not too pedantic for common use. There are, in fact, two psychologies: one which is constructed by the inner sense, and is the basis of the other, which might be called subjective psychology; and the other formed by outward observation, by the study of other men and of animals, or of the nervous system, which is the objective psychology of which we are speaking. The second psychology has always existed to a greater or less extent; but it is something new to treat it in and for itself, disengaged from the other, and to constitute it an independent science. One among the different parts of which it is composed seems to be more advanced than the others, and more nearly ready to claim to be a positive science. It is physiological psychology, or the science that studies the organic and physiological conditions of the mental faculties; and it

is in its turn divided into two parts, accordingly as it studies the sound man or the diseased man. The former is physiological psychology properly called, the other pathological psychology. This distinction is, however, more ideal than real, because so far the whole study has proceeded rather by the pathological road than by the direct observation of the healthy condition; but it is, nevertheless, correct in principle.

The matter of the new science comprises a number of facts not yet connected or co-ordinated, but which have been determined, to a certain extent. Among them are cerebral localizations, aphasia in particular, the muscular sense, heredity, suggestion, double consciousness, etc., besides others which have been longer known.

The theory of cerebral localizations was suggested by Dr. Gall and the phrenological school, who, however, compromised it by associating it with an untenable system, for which they did not offer a shadow of positive proof. Flourens approached the subject in a scientific manner, with experiments on the brains of pigeons, from which he deduced that the brain participates in the functions of thought and feeling as a single whole. He nevertheless opened the way to localizations by distinguishing various organs in the brain, and employing the distinctions of the spiritual philosophy between sensation and thought, seating the latter in the brain and the former in the spinal marrow. The theory of localizations has become much more precise since Flourens. Not only has it been possible to seat the motor functions and their various disorders with a quite novel precision in their several parts of the brain and spinal cord, but the mental faculties also have begun to yield to efforts to localize them. Thus, the faculties of pure thought have been placed in the gray matter; and the plurality of the cerebral organs and the diversity of their functions appear to have been established in the surest and most brilliant manner in the theory of the seats of language, in which the faculties relating to speech, reading, writing, and hearing are severally assigned their specific quarters. In this we have one of the clearest and most precise of the data of psycho-physiological science. The object of this science is the determination of the physiological or organic conditions of the mental faculties. In the present case the mental faculty is language; the plurality of seats is the organic condition; and this plurality explains the singular separations that are made in certain morbid cases between groups of phenomena absolutely homogeneous, as, for example, between reading and writing. Yet it is doubtful if we can go on to say that this explains language itself in so far as it is a psychological faculty. It is a case of cerebral topography and correlation, but nothing more.

One of the most obscure and complicated questions of physio-

logical psychology is the theory of the muscular sense. Destutt de Tracy maintained that without motion we could not have knowledge of the existence of bodies; for it is arrested movement that gives the sensation of resistance. The essential point in the theory is to distinguish the sense of effort from purely passive muscular sensations. If consciousness is a good judge in these matters, says Alexander Bain, we may say that in voluntary effort we have the feeling of a faculty experienced from within outward and not that of a sensible surface stimulated by an external agent and transmitting an impression from without to within the nervous centers. The sense of effort would then seem to be the feeling of the production of motion rather than of motion produced. It is anterior and not posterior to the motion. Without going into detail, we can, according to Bain, refer all muscular sensations to two great classes: the sensation of tension, and that of motion. Tension is an act of effort in so far as it meets an invincible resistance, for example when it endeavors to raise a weight that is beyond its strength, or to stop a galloping horse. We can distinguish three distinct sensations in that of tension: pressure, traction, and weight. The first occurs when we wish to crush an object, as a nut, with the hands; the second, when we wish to lead an object, as a horse, or a man who is resisting us; and the third, when we lift a weight. The first is an effort of ourselves on the exterior object; the second, of the exterior object on us; and the third, an upward effort. The feeling of tension is the same, whether the extensor or flexor muscles are involved. It is in a certain manner the feeling of force in equilibrium with the exterior force, but at its limit, and unable to go farther.

It is surprising that Bain, in discussing what he called the sensation of motion, did not first ask if such a sensation exists. Without doubt, since we effect motion, there must be something in the consciousness that corresponds to it; but does that something resemble what we call a motion—that is, a displacement in space? We see that the question of the sensation of motion is closely bound with the idea of the perception of space, or with the most obscure and complex question of metaphysics. Without this notion of space, the muscular sensation could not even take the name of tension or of contraction, for these terms imply motion, and motion implies space. The only peculiar characteristic of muscular sensation appears to be fatigue. Effort is an internal fatigue distinct from the external fatigue which is imposed by causes foreign to us. It consists in giving one's self a fatigue by the production of a desired act. We thus see how apparently the most elementary questions are complicated with those of the highest order. What, for example, is a desired act? The study of the simplest sensation, therefore, involves a theory of the will.

One of the most delicate questions of the theory of muscular sensations is that of defining tactual sensations. Having abstracted from touch all that relates to the sense of effort, what is left to constitute touch proper? Sensations of temperature, and what we call sensations of contact. But can there be sensations of contact without there being more or less of pressure, traction, etc.? Is simple contact felt, otherwise than as heat or cold, when we abstract all muscular sensation? Might we not simply revert from it, as did Biran, to the distinction between passive touch and active touch, the latter including the effort? But there appear to be pathological cases where the touch persists while the muscular sense is abolished, as, for example, where the patient with his eyes closed can not tell where his limbs are, whether his arm is raised up or lying down, etc.; but these cases relate to the localization of sensations, another of the most complex questions, and to that of the perception of our body, which is no less so.

There is left the physiological question proper, that of the seat of muscular sensation, on which there are two theories. According to what is called the centrifugal theory, the feeling of muscular effort is connected with the outgoing current of the motor influx. According to the other, the centripetal theory, it is produced by the sensations returning from the member in motion to the centers. Both of these theories find points of support in experiments made upon hysteric patients, who have in these days become veritable analytical machines for the use of psychology. On the one side are hysterics who, having lost the muscular sense, and shut their eyes, have no knowledge of the passive movements that are impressed on their limbs; and yet this loss of muscular sense takes away none of the precision of the motions which the subject executes; an observation which is interpreted by some authors as favoring the centrifugal theory; because, centripetal sensations being abolished with these patients, there must exist some condition of consciousness regulating their movements, and that condition of consciousness can be determined only by the outgoing current of the motor influx. There are, on the contrary, other hysterics who, losing consciousness of the passive movements, lose also that of active motions, and become incapable of executing a single act with shut eyes, which is interpreted as meaning that voluntary motions are impossible when centripetal sensations are abolished. This interpretation would indicate that there exists no feeling allied with the motor discharge and competent to regulate motions in the absence of centripetal sensations. It is apparent that physiology has yet very far to go before it can pretend to have solved these questions. But, as facts, the experiments in question are very interesting; and it happens

very frequently in the experimental sciences that we possess facts without being able to connect them by theories.

According to Kant's law, all our sensations are intensive quantities; that is, they are matters of degree. Can we, then, apply precise mathematical measures to their intensity? Every sensation does, in fact, present itself to us as being more or less strong, and consequently as a magnitude. Then why can we not measure it, like any other magnitude or any quantity? But we must mark a difference between psychological or physiological measures and the physical measures of physicists. As physics measures sounds, light, and heat, it might appear that we should already have been able to measure sensations. But it is obvious that physics measures these qualities only as objective properties of bodies, while the psychological measure of sensations is a quite other question. The present question, for example, is whether two quantities of light, physically and objectively equal, produce equal sensations, and unequal luminous causes produce unequal sensations—or whether, in short, the proportion existing between the causes also exists between the effects. "There is no one," says M. Ribot, "who has not compared two sensations and remarked that one is stronger and the other weaker. We declare without hesitation that there is more light at noonday than in moonlight, and that a cannon-shot makes more noise than a pistol." So far consciousness is sufficient; but this is not what we call measurement from the mathematical point of view. To measure a magnitude mathematically is to find how many times it is contained in another magnitude taken as unity. Has the sun a hundred or a thousand times more light than the moon? Does the cannon make a hundred or a thousand times more noise than the pistol? Such questions can not be answered by the consciousness, which can not tell us how many times one sensation is contained in another. It would naturally occur to the mind that sensation increases in proportion to the excitation, as when Herbart thought that two lights would give twice as much illumination as one. But this is not true. We hear distinctly sounds in the night, or in solitude, which are imperceptible in the daytime or in the hurly-burly of business. A double volume of sound is not produced when the number of instruments or of singers at a concert is doubled. A question is involved, calling for careful discussion in determining the proportion in which sensation is augmented or diminished with the excitation. This is one of the objects of what is called psycho-physics.

The question of heredity is another of the new matters which physiological psychology has introduced into philosophy. Till recently, the factor of heredity has been omitted in psychological treatises. In the schools of Condillac, Reid, and Jouffroy, the in-

dividual was considered as an absolute whole, sufficient in himself, and having no roots in the past. But the theory might almost be established *a priori*, for it is certain that heredity plays a part in the physical man. Every one recognizes the existence of hereditary diseases and the resemblance of children to parents. It is also generally acknowledged that the physical exercises a certain influence over the moral; it follows, therefore, that what is transmitted by the physical may be communicated, in a certain measure, to the moral. Yet much precaution is needed in the interpretation of these facts, for the law of heredity has to compete with another psychological law, that of imitation or of contagion by madness, the delusion, and the same delusion, is communicated to another by contagion and not by heredity. Undoubtedly, if the case is one of mother and daughter, it might be maintained that heredity plays a part; but, in the case of two sisters, there example. It is necessary, therefore, in discussing the facts on which the thesis of psychological heredity is supported, to select those with which it is possible to disengage these two elements from one another.

The fact of hypnotic suggestion, which has been so much talked of recently that it has nearly become wearisome, is nevertheless one of the most certain and best established facts. It causes astonishment solely by the extraordinary consequences which have been seen to be produced by it; for, at bottom, it was not unknown. It is a familiar fact that there can always be more or less of communication, in normal sleep, between the sleeper and the persons around him. No one is surprised, for example, that when music is performed in the presence of a person who sleeps through it without waking, he will say on waking that during his sleep he attended a concert of angels. The sensation has been entangled with the sleep, and has suggested by association a series of images which have a relation to it. It is known, also, that we can, in some cases, act upon the sleeping man, and obtain responses by speaking, or excite and direct his dreams by some other mark. This elementary fact, exaggerated and developed in certain organizations, and in particular diseases, especially in hysteria, has become the extraordinary fact of suggestion with all its consequences. It is not impossible to find its origin in the normal state. If we tell an infant that the murmuring wind is the voice of a weeper, or that a pale reflection of moonlight is a ghost, it will hear voices and see ghosts. The same fact, in hypnotism and hysteria, produces surprising phenomena. Movements, sensations, and more or less complex acts may be suggested to the hypnotized patient. Illusory sensations, and consequently hallucinations, can also be provoked. Like effects can be obtained without a real object, and by virtue of speaking alone, or

even by the simple association of ideas. Suggestion can even be brought to bear upon purely physical phenomena, as, for example, paralysis. We speak now of subjective burnings, of suggested blisters; and possibly the strange phenomena of stigmatics may have their origin in something of the kind. The suggestions of acts are the most important in this category, because they are what most cause somnambulists to resemble wakeful men, while passing from the domain of sleep into that of waking. They provoke the grave question of responsibility. Suggestions of this kind can be relegated to three groups: suggestions made during sleep of acts to be accomplished during sleep; suggestions made during sleep of acts to be accomplished during the wakeful condition; and suggestions during the wakeful condition of acts to be accomplished while awake. Here suggestion appears in its most wonderful manifestations; for examples are cited of suggestions enduring three months of incubation. Nothing is, without doubt, easier than to suppose a simulation under such circumstances; and our professors of hypnotism do not make efforts enough to invent counter-proofs and traps against imposture. But the number of facts bearing upon the matter is so considerable, and they are verified by so many examples, that a universal deception would be as hard to understand as the fact itself.

We can give only a bare outline of the facts here and will merely add that the question of suggestion raises many others; among them that of the relation of hypnotism to hysteria; that of hypnotic phases (lethargy, catalepsy, and somnambulism), which are affirmed at Paris and denied at Nancy; that of the passage from the normal to the suggestive state, and *vice versa;* the philosophical questions that are more or less involved in the discussion, such as those of free-will and responsibility, and the question of double personality.

The fact of sleep may of itself have already suggested the idea of two distinct persons, for we certainly are not the same sleeping and waking. Yet, in sleep, we have recollections from the waking state, and we can remember from sleep when awake. There is, therefore, an essential connection between the two states. There are in natural somnambulism at the same time more and less of analogy with the wakeful condition. In one respect it more resembles wakefulness; for while, in natural sleep, the dream is absolutely incoherent, the somnambulist plays out his dreams; that is, he executes a system of co-ordinated movements having a beginning, a middle, and an end, or a certain coherence. On the other hand, somnambulism is further separated from wakefulness in the fact that the man awake wholly loses the recollection of what the sleeping man has done, while the somnambulist can remember what he has done in a previous sleep. There are, then, in

some fashion, two lives, and the hypothesis dreamed of by Pascal is very near to being realized: "If we dreamed every night the same things, it would affect us as much as objects that we see every day; and if an artisan were sure to dream during the twelve hours of every night that he was a king, I believe that he would be almost as happy as a king who should dream for twelve hours that he was an artisan." Pascal speaks here only of dreaming, but it must not be forgotten that somnambulism is composed both of dream and reality. The somnambulist performs actions that take place in the real world; he walks, he writes, he does nearly everything that he does while awake, and is even able to speak and reply. Hence we have only to represent to ourselves somnambulism gaining more and more upon the waking condition, encroaching upon it, and at last becoming a second waking alternating with the other, and retaining only one feature of somnambulism—the loss of recollection on waking. Take the case of Felida, the celebrated subject on whom this double personality was observed for the first time. She (who I believe is still living) has two succeeding and alternating existences, in each of which she has a different character and different trains of thought; but above all remains the characteristic fact that, in the part of her life that corresponds with the former normal condition (for we can now hardly detect a difference between the two states), she does not recollect from her other existence, while in the latter she often remembers from the former. From this we have the expressions secondary condition applied to the second waking, and primary condition applied to the first waking, or original normal state. There are then two selves superposed in a fashion and alternating with one another. If at any moment the memory should disappear from the former state, the rupture would be absolute, and we should be in the situation imagined by Leibnitz*: "If we could suppose that two separate, distinct, and incommunicable consciousnesses were acting by turns in the same body, the one during the day and the other during the night, I ask if, in such a case, the man of the day and the man of the night would not be two persons as distinct as Socrates and Plato?"

To the phenomena of succession, are added those of simultaneous doubling of the personality. M. Taine cites an example of this in his work on "Intelligence," from the observations of Dr. Krishaben. A patient had lost the consciousness of his own existence, and had afterward reached the feeling that he was some other one than himself. "It seemed to me," he said, speaking of his first state, "that I was no longer of this world, that I no longer existed; but I had not then the feeling of being another." Of the

* The hypothesis is really not by Leibnitz, but by Locke, and Leibnitz has only reproduced it in his "Nouveaux Essais."

second state: "I felt myself so completely changed that I seemed to have become another being. This thought imposed itself upon me without my forgetting for an instant that it was illusory." We once saw, in the asylum of Stephansfeld, near Strasburg, a patient who was in the first state and had not yet reached the second, or who had perhaps passed it and had no longer strength enough to believe himself other than himself, for, according to his fancy, he had died in the night. He said to us: "You are very happy, you other people; you have a *me*, I have no longer a *me*." He did not even perceive the contradiction, and then we reminded him that he was living, and existed as much as we did. "No," he said, "it is the external powers that sustain me and cause me to live, but not myself." The poor fellow felt that life was escaping him and held only by a thread, that it was hung to some external condition, and expressed the thought in metaphysical terms, having probably made some studies in philosophy; he had at last exteriorized his consciousness, and was very near being some one else than himself. An example occurs in Gratiolet of a patient who imagined that he was in two beds at the same time. In cases of suicidal mania, it is not rare to see the subject doubling himself and hearing voices commanding him to kill himself. He resists; he replies, making the objection and the response at the same time, but he does not believe that it is himself doing both. This is what happens also in spiritualism and in the case of writing or speaking mediums. But in all the preceding cases we perceive that, of the two personalities, one is illusory. A case is presented of optical illusion of the consciousness as there is an optical illusion of the senses; a false interpretation of the phenomena of consciousness, which refutes itself. In the recent experiments in provoked somnambulism, however, we have come to the point of separating distinctly two consciousnesses, one of which seems to be as real as the other. A person converses with you while he is writing a letter, or making a complicated calculation, one of the two personalities not knowing what the other is doing, but each being aware of what itself is doing. This is the most advanced and at the same time the most obscure point of the question.*

These are the principal facts with which psycho-physiological science occupies itself. There are many others which it would be tedious to recite; the law of association between ideas and motions, the unconscious motions, the theory of which M. Chevreul began in his work on turning tables; the theory of physiognomy, of which Duchesne de Boulogne has established the physiological basis, and from which Gratiolet and Darwin have drawn psychological results; researches on memory, the theory of hallucination, and

* See the remarkable experiments of M. Pierre Janet, Professor of Philosophy at Havre; "Revue Philosophique," December, 1886; May, 1887; and March, 1888.

the whole domain of mental pathology. Here is a vast field for study for which we are better equipped to-day than ever. There is certainly in it the material for a science, and consequently the basis for a system of instruction. Yet suspicions and scruples, explainable but exaggerated, have been raised against these new studies. It will be well to point them out and estimate them in order to fix, as far as possible, the principles of the question.

It is remarked, first, that physiological psychology is not yet a made and established science. It is, they allege, only a confused mass of doubtful facts and arbitrary opinions; only a collection of hypotheses that have no authority at all in science, and therefore no right to be taught. I admit that there is much in physiological psychology that is conjectural and arbitrary, and that there is too much haste to rush to conclusions and doctrine; but the assertion that there are no certain facts in it, nor a certain number of positive laws, or at least of legitimate researches, appears to me to be refuted by the preceding summary. There is, therefore, a science in a nascent state, a science in the course of formation. The question now is, whether such a science ought to be taught. Instead of seeing an objection in the transitory condition of the science, I see in it only an additional reason for teaching it. The nascent science is the one that needs to be taught. There was great reason for creating in the Faculty of Sciences the chair of Microbiology, although that science was only born yesterday, and changes from day to day to such an extent that the professor may often find himself between one day and another in the presence of unexpected facts that will constrain him to modify his previous assertions. But there was all the greater need of such a chair; for where could any one desiring to occupy himself with this science, and to work for its further progress, prepare himself for it? So with psycho-physiology. Suppose a young philosopher or physiologist, attracted by studies of this character, and wishing to devote himself to them; where could he learn the elements of this science? They are scattered in thousands of volumes of philosophy and medicine, where they are mingled with everything else. Only to examine these books is an infinite task. Add that they are not always easy to get, that no one has them all in his library, and that most of them are written in foreign languages; and, further, that frequently the most important facts are not in special books, but in the memoirs of academies, in the collections of scientific societies, and in scattered pamphlets; and all this without connection, unity, or method. How can any one acquaint himself with it without a guide, without a leading thread? The object of the new chair is to furnish such a guide. Teaching is, therefore, the precise thing necessary to bring the science out of the nascent state.

A more formidable apprehension is the one that there will slip in, under the name of physiological psychology, not a science, but a doctrine, and this—to call things by their right names—the materialistic doctrine. This objection should be examined to the bottom; it is important to have it removed, not only in the interests of sound thought, but also in those of the science which is concerned. Nothing could be more fatal to the future of this science than to give it a materialistic significance.

In principle, psycho-physiological science is neither materialistic nor spiritualistic. It is, or ought to be, exclusively experimental and scientific. Its disinterested character in this respect is proved by the fact, which has not been sufficiently insisted on, that it was founded by men of spiritual belief: the spiritualist Descartes; after him the mystic Malebranche; and, succeeding them, Charles Bonnet, of Geneva, the most religious man of the eighteenth century. Among contemporary German psychologists, as named by M. Ribot, are Lotze, an avowed believer in spirit, who has revived Leibnitzianism in Germany; Helmholtz, the great physicist, is a Kantian, as also is Wundt, the chief of the school, who declares that physiology can account for the inferior but not for the superior faculties of the human mind; Fechner, the discoverer of the law that bears his name, is an illuminate far more spiritual than materialistic; and Weber is a pure physicist, indifferent as between metaphysical schools. Thus, not one of the most authoritative masters of the new science in Germany is a materialist. The same can not be said of all the physiologists who are occupied with these questions; but the science itself is indifferent as between the two doctrines, and can associate itself with either. Yet, to be just, and not to hold to appearances only, it is clear that a science which occupies itself with the physiological conditions of thought, or with the part played by matter in the operations of the mind, will always have a color of materialism. If Descartes had only written the first part of the "Treatise on the Passions," in what could this treatise be distinguished from Lamettrie's "Homme-Machine"? Suppose, now, that in consequence of the multiplication of objects of study, and through the division of labor, an author should limit his studies to the first order of researches, without adding the corrective, as Descartes did in the third part of the "Passions," should that make him pass as a materialist? Certainly not. All that we can ask of him is to leave such questions open.

A second right that can not be denied to psycho-physiology is that of establishing and affirming facts, whether or not they be agreeable to this or that doctrine. For example, the fact of hypnotic suggestion recently brought to light has a frightful appearance to many minds, who believe that it involves the overthrow of

moral and social order. The fear is exaggerated and chimerical; but that is not the point to be considered. A fact is always a fact, whatever may be the consequences. The question is, whether it is true; the student should recognize no other. Many of the facts encountered in our studies are obscure and hard to explain, but that does not prevent their being facts; or at least the chief question should be, to learn whether they are facts. Besides, contradictory facts are the ferment of science. I once asked a distinguished man of science how a certain discovery he had made was getting on. "It is not getting on," he replied. "What is the matter with it?" I anxiously asked. "Why," he said, "I find no facts except those which are favorable to it; and," he added, "it takes contradictory facts to teach us." This is true. The theory will either explain the contradictory facts and be fortified by them, as the Newtonian theory has been by all the exceptions that have been opposed to it and which have entered into it; or it will be replaced by a wider and more comprehensive theory. In both cases there is a gain for science, which would not have been obtained if we had hesitated, on account of vain scruples, to seek out and verify the facts in question. In principle, every science should be independent of those which come after it. Chemistry, for example, whether organic or physiological, in studying the chemical conditions of life, is held to one thing only—to seek out and discover those chemical conditions—and has no other function. It is not for it to occupy itself with the interests of vital force nor with anything that concerns the vital. Its right and duty are to push as far forward as possible the chemical explanation, for who else is to do it? Then comes the physiologist. His business is to bring into the light the new element which has been added to the former. Chemistry could have been preoccupied with this only to its detriment. If chemistry had been concerned to take care of the existence of the vital principle, it would not have achieved the splendid discovery of organic synthesis which has made the name of M. Berthelot illustrious. Does this signify that life is not a chemical fact? Not at all. But it belongs to physiology, and not to chemistry, to exhibit the peculiar quality that distinguishes the one science from the other.

Applying these principles to psycho-physiology, all the clouds that obscure the question are dispelled. The function of psycho-physiology is not to establish the existence of the soul; that belongs to pure psychology and metaphysics. How can we expect to find the soul, personality, freedom, in the study of the organs? The interests of the soul would therefore be very badly placed in the hands of psycho-physiology. They are better confided to other hands; and in touching upon these higher questions, that branch would be doing an injury to the cause which it assumed to serve.

Flourens thought he had found a triumphant argument against materialism when he concluded that the brain was a simple and not a multiple organ, the unity of the brain appearing to him to be the proof and the security of the unity of the self. If his argument had been sound, the spiritual doctrine would to-day have been condemned by its own acknowledgment, for it now seems certain that the brain is not a simple but a composite organ.

This kind of independence is generally conceded to all the other sciences which are recognized and have had a long existence. Thus, we do not require political economy to establish the principle of duty, or history to prove the existence of a Providence. There is or there is not a Providence; but the historian knows nothing about it. There is or there is not a principle of duty; but the economist, as an economist, has no cognizance of it. We often even regard as culpable doctrines which make morals intervene in political economy, such as the socialist doctrines which aim to impose devotion and fraternity upon economical transactions. We admit that the law of competition is cruel, but we do not wish as economists to introduce a law of charity to correct it. That is a matter of morals, not of political economy. It is by observing such precise distinctions that political economy has succeeded in constituting itself as a science. This independence is useful not to political economy only, but to morals as well, which has no interest in seeing its peculiar principle confounded with the peculiar principle of the former science, which is mere utility.

The same is the case with history as related to theodicy. Surely, if there is a Providence, it should manifest itself in the series of human events. But no historian of the present, not even the most pious and most Christian, would think of bringing the name and action of God into his history. We explain all historical events by second and profane causes, often also by material or geographical conditions, as when the whole history of England is accounted for by the fact that it is an island. The intervention of gross passions is brought in; sometimes fortuitous encounters or physical needs are invoked; as when the invasions of the barbarians are accounted for by the necessity of their finding food. No historian would say to-day, in a book on the "origins" of France, that God urged the barbarians on, as Salvien did in his "De Gubernatione Dei." One might have religious scruples against pronouncing the name of God in the minor events of history; against saying, for example, that God desired that the Abbé Dubois should be nominated a cardinal, or that Du Barry should enter the bedchamber of the king. What would such a historian reply to a critic who should object to him: "You never pronounce the name of God; you never speak of Providence; your science is

atheistic"? The historians of the present time would be astonished at such an objection. But it is of the same kind as that which is made when physiological psychology is reproached with not speaking of the soul, of freedom, and of personality, and with only recognizing the physical conditions of phenomena, although that is the only problem which it pretends to resolve.

As a rule, all the sciences that study the conditions necessary to a higher development can be called, in a qualified way, materialistic with reference to the higher sciences. They are certainly so in the sense conceived by Aristotle, to whom matter was only the basis on which was built and to which was added a new form; and it is still a question in metaphysics whether there is any other matter than that. In the Aristotelian sense, chemistry is materialistic in relation to physiology; physiology in relation to psychology; political economy in relation to morality; geography in relation to history, and history in relation to theodicy. Psycho-physiology thus appears to be in the same condition as the other sciences. In itself it is less materialistic than physiology proper, because it adds an element, consciousness, which physiology does not recognize; but it is more materialistic than psychology proper, which studies consciousness itself and in itself.—*Translated for the Popular Science Monthly from the Revue des Deux Mondes.*

CUSTOMS AND ARTS OF THE KWAKIOOL.*

By GEORGE M. DAWSON, D. S., F. G. S.

DURING the summer of 1885, the writer was engaged in the geological examination of the northern part of Vancouver Island and its vicinity, the territory of the Kwakiool people. In connection with the prosecution of his work, he was in constant and intimate association with this people, and enjoyed many excellent opportunities of obtaining facts respecting them, of hearing their traditions and stories, and of becoming familiar with their mode of life and habits of thought. The notes, made at the time, are here presented in a systematized form. As thus set down in order, they are intended to be merely a record of facts and observations, and are offered as a contribution toward our knowledge of the Indians of the west coast. Notwithstanding diversity of language and dialect, these coast people form a single group in respect to arts, and to a less extent in regard to customs and traditions. The useful arts and modes of construction have

* Abridged from a paper entitled "Notes and Observations on the Kwakiool People of Vancouver Island," presented to the Royal Society of Canada, May 25, 1887.

evidently been readily adopted by various tribes from whatever source they may have originated. In dexterity and constructive skill, as well as in artistic representation, the Haida people, however, excel all the others.

The villages consist usually of a single row of houses ranged along the edge of the beach and facing the sea. The houses are generally large, and are used as dwelling-places by two or more families, each occupying a corner, which is closed in by temporary partitions of split cedar planks, six or eight feet in height, or by a screen of cloth on one or two sides. Each family has, as a rule, its own fire, with cedar planks laid down near it to sit and sleep on. When, however, they are gathered in the houses of smaller and ruder construction, at summer fishing-places, etc., a single fire may serve for a whole household. The household effects and property of the inmates are piled up round the walls, or stored away in little cupboard-like partition spaces at the sides or back of the house. Above the fire belonging to each family is generally a frame of poles or slips of cedar, upon which clothes may be hung to dry, and dried fish or dried clams are stored in the smoke. Eating is a perpetually recurring occupation, and smoke appears to ooze out by every chink and cranny of the roofs of the large houses, the whole upper part of which is generally filled with it. The houses of the Kwakiool are not so large or so well constructed as those of the Haida, though, if Vancouver's representations of them are to be accepted as accurate, they are more commodious and better built now than in his time. The introduction of metal tools may have produced a change of that kind. Wood-carving is practiced, but not so extensively as among the Haida, and carved totem-posts are not nearly so numerous nor so large or artistic in design as among that people. Such examples of posts of this kind as occur are also invariably separate from the houses, and no instance of a carved post forming the door of a house was seen in any of the villages.

The most valuable possession of the Kwakiool and other northern tribes is the "copper" or copper plate of which the peculiar form is illustrated in my "Report on the Queen Charlotte Islands." A conventional face is often scraped out upon the surface of the "copper." The most valued coppers are very old and have been handed down for generations. These are known as *tlā-kwa.* Smaller "coppers" of modern manufacture are named *tlā-tloh-sum.* A copper, to be of value, should be of equal thickness throughout, except at the edges, where it should be thicker than elsewhere. When struck, it should emit a dull sound and not ring. The dentalium shell, named *a-tl-a,* was formerly used as a currency, but, as with other coast tribes, the blanket is now the unit of value. A somewhat inferior quality, known in the Hud-

son's Bay Company parlance as a "two-and-a-half point" blanket, is the standard, and is named *ul'-hul-as-kum.*

When a child has grown large enough to leave the little cradle, tied into which it spends most of its earlier days, usage demands that the cradle, together with all the wrappings and bark forming the bedding and its appendages, shall be carefully collected and carried to a recognized place of deposit. This custom is not now strictly adhered to with regard to the cradle, but is still obligatory in respect to the bedding, which is generally neatly packed in a box or basket, and laid away, never to be touched again. Every village probably has such a place of deposit. That for the Kā-loo-kwis village is a sheltered recess in limestone cliffs at the western extreme of Harbledown Island. It is named *kī-ats-a-kwāsh'*, or "cedar-bark deposit-place." Another similar recess in a cliff, filled with cradle wrappings, exists on the south side of Pearse Peninsula, east end of Broughton Island. At Mel'-oopa and at Hwat-ēs' there are similar places, that at the first-named village being beneath logs, at the back of the village, and not on the shore.

When a young man desires to obtain a girl for a wife, he must bargain with her parents, and pay to her father a considerable number of blankets. Owing to the great desire to accumulate blankets for the purposes of the *potlatch* or donation-feast, together with the scarcity of marriageable girls, the parents are very strict and exacting in this respect. The young man is often still further fleeced by his wife, who, at the instigation of her parents, may seize upon some real or imaginary cause of grievance and leave him. The father then exacts a further blanket payment for her return, and so on.

Medicine, or sorcery, as practiced by these people for the cure of disease, is much the same as among other tribes of the coast, though the peculiar tubular bone charm, employed by the Haida and Tshmisian, was not here observed. The sorcerer may be either a man or a woman, famed for skill in such matters, to whom their vocation may have been indicated by dreams or visions. Medicines may be given to the patient by his friends, but the sorcerer does not deal in drugs, devoting his attention solely to exorcising the evil principle causing the disease. This is done by singing incantation songs, the use of a rattle, and vigorous sucking of the part affected, which in many cases is kept up for hours and frequently repeated, and must always be handsomely paid for. Sickness is still, generally, and was formerly at all times, attributed to the witchcraft of enemies. Certain persons were known to possess the power, and were called *ē'-a-kē-nooh.* Such a malignant person, wishing to bewitch an enemy, is supposed to go through a series of complicated and absurd cere-

monies, of which the following is an outline: An endeavor is first made to procure a lock of hair, some saliva, a piece of the sleeve and of the neck of the dress, or of the rim of the hat or head-dress which has absorbed the perspiration of the person to be bewitched. These are placed with a small piece of the skin and flesh of a dead man, dried and roasted before the fire, and rubbed and pounded together. The mixture is then tied up in a piece of skin or cloth, which is covered over with spruce-gum. The little package is next placed in a human bone, which is broken for the purpose, and afterward carefully tied together and put within a human skull. This again is placed in a box, which is tied up and gummed over and then buried in the ground in such a way as to be barely covered. A fire is next built nearly, but not exactly, on the top of the box, so as to warm the whole. Then the evilly disposed man, beating his head against a tree, names and denounces his enemy. This is done at night or in the early morning, and in secret, and is frequently repeated till the enemy dies. The actor must not smile or laugh, and must talk as little as possible till the spell has worked. If a man has reason to suppose that he is being practiced on in this way, he or his friends must endeavor to find the deposit and carefully unearth it. Rough handling of the box may prove immediately fatal. It is then cautiously unwrapped and the contents are thrown into the sea. If the evilly disposed person was discovered, he was in former years immediately killed. If, after making up the little package of relics as above noted, it is put into a frog, the mouth of which is tied up before it is released, a peculiar sickness is produced which causes the abdomen of the person against whom the sorcery is directed to swell.

After death the body is immediately coffined, not a moment being lost. Should death occur at night, the coffin-box is set outside the house at once, till daylight may admit of its being disposed of. The face of the dead is first washed and the hair combed, and then the face and head are painted with vermilion and the body wrapped in blankets by near relatives or friends. It is then put into any box of a suitable size that can be found, generally one of those used for the storage of house effects or dried fish. The box so employed is named *tik-ī-ā'-tse*. The body is doubled up, and no hesitation is felt in using violence toward it in order to press it into the box. The graves of the Kwakiool are of two principal kinds: little scaffolds to which the coffin-box is lashed, high upon the branches of fir-trees, and known as *tuh-pē'-kh*; and tombs built of slabs of wood on the ground. Small tent-like erections of calico are now often substituted for the latter, and the bodies of relatives or friends, dying at different times, are in both cases often placed together. If a person of importance or much

respected, a canoe (previously rendered unserviceable) is often drawn up and deposited near the grave. The trees used for the deposit of the dead are often quite close to the village, but when a tomb is placed upon the ground, it is generally on some rocky islet or insular rock, which may be farther away, but is still in sight from the village. Such islands become regular cemeteries. Graves in trees are generally festooned with blankets or streamers of cloth, and similar appendages are affixed to poles in the vicinity of graves on the ground. Roughly carved human figures in wood are also often added. These sometimes hold in their hands wooden models of the copper plates which are so much valued by these northern tribes of the coast. Similar models are also at times nailed up on posts near the graves. At Pā'-as (Blunden Harbor) the upper part of one of these coppers (but one of inferior value) was found broken in two and affixed at a grave in token of grief. The lower part was not found, and had probably been used before on some similar occasion. At Fort Rupert and Alert Bay, bodies are now frequently buried in the ground, owing to the influence of the whites. Such a grave is named *tik-ī-ās.*

After the body has been deposited in the grave, a fire is made near it, in which some food is burned, such as dried salmon, fat, dried clams, etc., and all the smaller articles belonging to the deceased are thrown into the fire at the same time. The canoe, house, and other larger effects are then taken possession of by the son, father, daughter, wife, or brother of the dead, generally in the order named The wife or husband of the deceased goes into special mourning for a period of one month among the Queen Charlotte Sound tribes, or for four months among the Kōs'-kī-mo. The survivor lives during this period separately in a very small hut, which is built behind the house, eating and drinking alone, and using for that purpose dishes not employed by other members of the tribe. The near relatives of the dead cut their hair short, or, if women, cut a small portion of it off. A widow marks her face with scratches, in token of mourning; among the Kōs'-kī-mo she cuts her face with a shell, and does not generally marry again for at least a year. In some cases, about a month after death, the men of the tribe collect in a house to sing a song which relates the deeds and virtues of the deceased. This is named *sā'-luma* or *kwai'-um,* the "crying-song." Children are sometimes, in the same way, mourned for by the women. When at Mel'-oopa ("Nawitti") in 1878, the first sound we heard at daybreak was the crying and lamentation of the women, the song being taken up first by one and then by another, in different parts of the village. This, it was ascertained, was in consequence of the death of a boy which had occurred some time before.

In my notes on the Haida people of the Queen Charlotte Isl-

ands, the facts which could be obtained as to the *potlatch* or donation-feast of these Indians and of the Tshimsian were detailed. This custom is common to all the coast tribes of this part of North America, and has extended, though in a less marked form, into the interior of the continent. The main features of the custom are probably identical, or nearly so, among all the tribes of the British Columbia coast. They are certainly nearly the same with the Haida, Tshimsian, and Kwakiool peoples. Among the latter, this ceremony is known as *pus-a* or *ya-hooit*, these terms probably denoting special forms of the ceremony appropriate to certain occasions.

As a particular instance of the custom, let us suppose that a Nīm'-kish, of Alert Bay, has collected together as his own, or obtained control of, say, five hundred blankets, and wishes to make a potlatch to the Fort Rupert tribes. He goes to the Fort Rupert village and makes known his intention of distributing a thousand blankets at a certain date. He begins by lending out his stock of five hundred blankets, giving larger numbers to those who are well off, and particularly to such as are known to have the intention of giving a potlatch in return. This loan is reckoned a debt of honor, to be paid with interest at the proper time. It is usual to return two blankets for every one borrowed, and Indians with liberal ideas may return even more. The greater the number of blankets loaned out to any individual, the more he knows that his wealth and standing are appreciated by the stranger, who, later on, taking with him a thousand or more blankets, returns to his home at Alert Bay; at which place also, in due time, the Fort Rupert people arrive. The potlatch does not, however, then occur at once, as much preliminary talk, ceremony, and feasting are in order, and the Nīm'-kish must entertain their visitors—first one and then another volunteering feasts and diversions. It may also, very probably, happen that delay arises because the man about to give the potlatch has not obtained the requisite number of blankets, many being owing to him and others having been promised by friends whom he is obliged to dun. The Fort Rupert people, becoming weary of waiting, lend all the weight of their influence to coerce the debtors into payment, and these may, in the end, be forced to borrow from others to enable them to redeem their pledges—all such arrangements leading to interminable haggling and worry. At length, however, all is ready, and, with the accompaniment of much bombastic speech-making and excitement, the mass of blankets is distributed in exact proportion to the social position of those taking part—or, what is the same thing, in proportion to their individual contributions.

To surpass the man who has last given a potlatch, and acquire a superior standing to his, the next aspirant must endeavor to

give away more than a thousand blankets, and will strive as soon as possible to be in a position to do so.

The nominal excuses for giving a potlatch are numerous, the most common being, however, the wish to assume a new and more honorable name. The name proposed to be taken passes by common consent, if the potlatch shall have been successful and on a sufficient scale.

Should an Indian wish to humiliate another for any reason, he may destroy a great number of blankets or much other valued property. This, according to custom, leaves his adversary in debt to the amount of the property made away with. It then behooves the debtor to bring out and destroy a like or if possible a greater amount of property. If he is not able to do this, he lies under the reproach of having been worsted by his foe.

The difficulties attendant on any effort toward the improvement of the condition and mode of life of the coast tribes of British Columbia are very grave; and the actual results of missionary labors, such as those carried on by Mr. Hall among the Kwakiool, and other self-sacrificing persons elsewhere, are in most cases, to all appearance, small.

It is difficult to induce individuals to abandon their old customs and bad habits, and nearly impossible to prevent them from relapsing, from time to time, owing to the fact that they still live promiscuously among and herd together with the mass of the tribe. Since the arrival of the whites, the Kwakiool, equally with other tribes, have become, in a word, "demoralized." They have lost, to a great extent, their pride and interest in the things which formerly occupied them, losing at the same time their spirit and self-respect, and replacing it by nothing. It is comparatively easy at all times to obtain a sufficiency of food, and food is at some seasons—as during the salmon-run—to be had in the greatest abundance with very little effort. Beyond this, there is nothing more to occupy their time fully and to keep them out of mischief. They are restless and unhappy. In some seasons, good wages are to be obtained by picking hops in the vicinity of Puget Sound, and it has thus become customary for many of the tribes to go south in the autumn, nominally for this purpose, but in reality with no great prospect of obtaining work. They may then be seen leaving their villages in bodies in their large and well-built traveling-canoes, whole families together with their household effects and children, and three, four, or five paddlers to each canoe, setting out cheerfully enough on their voyage of two hundred miles or more. They may obtain a little money while away, which they invest in goods and whisky, if they can obtain it (and in this there is unfortunately very little difficulty). They live, however, in the vicinity of Victoria and other large towns in a

state of shameless debauchery, and thus very often return in a diseased state to their homes.

The condition of these people is in no sense bettered by endeavoring to teach them moral maxims or religious dogma. They do not appreciate the truth of the former, nor can they in their low mental state rightly understand the latter. To endeavor to do so is merely to imitate the procedure of the Indian shaman over the dying. If, on the contrary, you speak to them of means of improving their material condition, or deplore with them the rapid diminution of their tribe, the more thoughtful and mature listen with the greatest respect and attention. The problem is, fundamentally, an industrial one, and is to be attacked, if successfully, from that side. They are naturally industrious enough, and capable, though not so persistently laborious as the whites, and less easy to control than the Chinese. They obtain a certain amount of precarious employment in connection with the canneries and other nascent industries of the northern coast, but have not generally the offer of any permanent remunerative work.

It is thus primarily essential to establish industries among them which will remove the temptation now felt to drift to the larger settlements and towns. Improvement in mental and moral tone will then naturally follow.

LINES OF PROGRESS IN AGRICULTURE.

By Dr. MANLY MILES.

THE recent progress made in the study of social and political science, in which the principles of evolution have played an important part, must aid us in gaining a better knowledge of the laws of industrial development, and more consistent views of the real objects and available methods of industrial education.

The recognition of the fact that in the social and industrial progress of peoples, as well as in the relations of natural phenomena, there are laws of growth and development, of universal application, under which the modifying influences of surrounding conditions are brought in harmony in determining results, has widened our methods of study and research, and thrown a light on the history of the world's progress that enables us to trace the relations of cause and effect in many cases that had before been involved in obscurity.

In agriculture there is pressing need of the application of principles and methods that have aided in the development of other industries, to enable the farmer to devise the best possible system for the profitable practice of his art under the world-wide com-

petition which surrounds him, as the result of the wonderfully increased facilities for the transportation and exchange of commodities. He can no longer claim that the empirical knowledge of farming he may possess is the only consistent guide in practice, and he can not safely ignore the many lessons presented in the marked progress and revolutions that have been made in other industries, or the manifold benefits he may derive from the wide circle of sciences, which are now in their rapid development suggesting important applications in every interest and process of the farm.

Practice and science must go hand in hand, with the most hearty co-operation, if the problems in farm management arising from the world's progress and the consequent depression in prices are to be successfully solved. Every hint which the latest discoveries in science may present for his consideration must be closely studied, and its relations to practice carefully determined, or the best results can not be obtained. From the complexity and interdependence of all agricultural processes and their intimate relations to every department of science, it must be admitted that there is no business or profession in which so wide a range of knowledge can be profitably made use of as in farming.

The ruts followed by narrow specialists, and the ultra-conservatism of the so-called "practical men," are alike to be avoided, if real progress in the practice of agriculture is made. A broad and liberal culture, with special training and aptness for the work, is required in dealing with the practical applications of the latest contributions of science, as no department of research can be safely neglected in the broad field which embraces such widely different interests; and this fact must be fully recognized in the management of our agricultural colleges, or they will fail to accomplish the end for which they were established.

In the popular discussion of manual training in schools as a phase of the modern demand for industrial education, there is danger that too much stress will be laid upon the assumed advantages of manual dexterity as a preparation for acquiring some handicraft or trade, and that its real value as a factor in mental development and discipline will be overlooked in the efforts to give a practical bias to an elementary course of instruction.

A brief glance at some of the conditions under which the world's work is now performed will make it evident that breadth of culture and thorough training in methods of scientific investigation are of greater importance than manual dexterity in any special direction. The trades or handicrafts which formerly required an apprenticeship of several years for their mastery are now, in effect, made nearly obsolete by the invention of machinery, and specialization in the processes of production, together

with the demand for large investments of capital, in every department of manufacture, to meet the intense competition arising from the rapid development of new and improved methods, and increased facilities in the means of transportation and distribution. In manufactures of all kinds the margin of profits has been reduced to an extent that is fatal to small establishments, and production can only succeed when on a sufficient scale to make an aggregate of the small items of profit an object worth seeking.

The subdivision of labor required in the specialization of manufactures on a large scale, where machinery, adapted to the particular purpose, is made use of in every process, tends to diminish the demand for skilled artisans, unless they are needed as superintendents of labor; and even then executive ability, general intelligence, and a knowledge of business methods, are of greater importance than mere technical skill.

The work done by a skillful mechanic, under former methods, is now performed by an unskilled workman and a machine, under proper supervision, and with greater economy and certainty in the results. Dexterity is required in only a single movement or operation, which is soon learned, and, when a machine is properly adjusted to perform its special function, a boy with its aid becomes the equal of the most skilled artisan in the routine of work he has to do. With the exception of localities with scattered population and remote from the lines of trade and distribution, we shall find that wagons, carriages, agricultural implements of all kinds, boots and shoes, tinware, clocks and watches, and, in fact, almost every product of the industrial arts, can be purchased at a lower price than the artisan can afford to make them under the old methods of his trade, and his skill as a workman is only in demand to repair the articles originally produced under a specialized system of manufacture.

Moreover, in many of the industries competition is so sharp, and the margin of profit so small, on the leading object of production, that the utilization of what had been waste products has been found to be essential to financial success. In response to this demand for the working up and utilization of residues, the applications of chemistry have produced remarkable results, and in many instances what had been rejected as a waste has assumed a dominant position in the industry, and the original article of manufacture has in its turn become the by-product and of secondary importance on the score of profit.

Large investments of capital, specialization in production, the use of machinery in every process, and the consequent subdivision of labor in particular lines in which the technical skill of the handicraftsman is not required, together with the utilization of

waste products and the rapid exchange of commodities, mark the progress of activity in the industrial arts.

Industrial education in its widest sense, in which mental development and liberal culture are the leading aim, in connection with a thorough knowledge of the industries in their relations to science, should be promoted as an important factor in the world's progress, and the gaining of technical skill in the handicrafts which have been so largely superseded by modern improved methods should not be allowed to usurp a dominant influence.

In the struggle necessarily involved in the progress of civilization and social development, agriculture is fortunately exempt from many of the conditions of production which have a decided tendency to reduce profits in other industries, and aside from the effects of bad seasons, the ravages of insects, and similar agencies which are local in their influence, the competition arising from the rapid increase in facilities for transportation, which give remote localities a ready access to the markets of the world, becomes the most important element in determining the low price of farm products.

This competition can not be evaded, and its tendency must be to prevent any wide fluctuation in the market value of products; and the farmer can have no reasonable expectation of again obtaining the high prices for his products which have been realized in the past. As in other industries, the fact of a world-wide competition and a resulting small margin of profits must be accepted as a probable constant factor in the farming of the future. This should not, however, be considered as a discouraging outlook, but it should serve as an incentive to activity in developing improved methods that will give satisfactory results under the prescribed conditions of production.

To those who are familiar with the details of farm practice, and have also a knowledge of the manifold applications of science that are available in every department of production, the direction in which progress can be made in devising remedies for the present diminished margin of profits in farm products is obvious. Attention must be directed to the development of a complete and comprehensive system of farm management, in which the intimate relations and interdependence of interests, in every department of production, are fully recognized, and every detail of practice, under thorough business methods, is made to yield the best direct results, and at the same time contribute indirectly to the aggregate of profits by its favorable influence on other details of equal importance. This will, of course, involve the systematic and consistent application of every contribution of science to the art to secure the utilization of every element of production, and the strictest economy in the distribution of the required labor.

From the prominence given to the economics of farm management and the inseparable relations of practice and science, as factors in the progress of agriculture under its present well-defined conditions, the notion must not be entertained that a complete revolution in practical methods is needed. The general principles of farm practice have been well established by the teachings of experience, and the leading rules of the art are not likely to be superseded or essentially modified by any discoveries in science. The old landmarks which have been obscured or lost sight of from too exclusive attention to specialties of comparatively little importance, must be restored and clearly defined, as a foundation on which a superstructure of improved practice in harmony with the principles of science and the prescribed conditions of production may be safely developed. New methods are not so much needed as a systematic adjustment of details, under the old established rules, in order to secure greater certainty and exactness in results.

Development, and not revolution, must be the watchword of progress, and the generally accepted methods of practice should only be modified by a proper arrangement of details to adapt them to the new environment. Exclusive attention to special farm products, and intensive systems of cultivation, have been urged as a royal road to success, in what has been called "progressive agriculture," by those who have noticed some of the improved methods in other industries, and attempted to apply them in agriculture without any definite knowledge of existing methods of farm practice, or the available applications of science in the art. These mistaken views do harm from the defective data and hasty generalizations on which they are based, which tend to bring true science undeservedly into disrepute, and also by diverting attention from the real methods of improvement.

From wide differences in the conditions of production, it must be readily seen that the centralization and specialization in manufactures, and the consequent subdivision of labor, which have been found essential to success in other industries, can not be applied in agriculture. With the exception of the comparatively few cases in which peculiar local conditions may warrant a departure, to some extent, from correct principles of general practice, it will be found that the specialization of products, instead of mitigating the evils arising from active competition, will only add to their intensity.

The tendencies of high farming are in the same direction. Sir John Bennet Lawes has clearly shown, from experimental data, that intensive farming can only be successfully practiced when comparatively high prices for farm products are obtained; and he concludes that high farming can not be recommended as a remedy for prevailing low prices. In agriculture, increased pro-

duction beyond a certain limit, which will vary with different conditions, involves an increase in the cost of the product, and with low prices an increase in yield, under an intensive system of management, may be made to cost more than its market value. With prevailing low prices for staple products, mixed farming, when conducted on a comprehensive plan, that gives to each interest its legitimate influence on the aggregate of results, has many advantages which recommend it as the best general system of practice.

Of the available suggestions which the rapid progress and development of other industries may present for the farmer's consideration, strict economy in the management of labor, and the thorough utilization of waste products, are undoubtedly the most significant. These two topics are so closely connected in practice from their intimate relations to every department of production, that they can not be separately considered in planning a system of farm management.

The direct influence on the margin of profits, of the distribution and efficiency of the labor performed on the farm throughout the year, is, however, so obvious that it will answer our present purpose to refer to it as an element that can not be neglected in discussing other methods of improvement. The waste products of the farm, which are so generally neglected, require more than a passing notice; but the limits of this article will not permit a full discussion of the subject, and we can only call attention to their great economic value.

From a careful estimate, based on the best obtainable data for the year 1884, in which the most important elements of fertility are valued at their market price in the form of commercial fertilizers, the barn-yard manure (or what should be utilized as such under a good system of management), in the State of Michigan, is worth at least $35,000,000; and in the United States this residue, under the same method of valuation, gives the astonishing aggregate of $1,092,950,000, which is more than twice the market value of all agricultural exports for the same year.

Persons familiar with the details of farm practice in different parts of the country will consider it safe to assume that at least one half of this valuable residue is lost, through neglect and errors in management, from lack of knowledge of the best methods of conserving the elements of fertility. The annual loss to farmers of the United States of a sum equal to, or exceeding, the market value of all agricultural exports, which they may readily prevent by a thorough and consistent system of management, is a matter of the first importance in considering the available means of agricultural improvement.

It does not aid the farmer in the ordinary routine of his work,

or place him in a better position to overcome the evils of the intense competition to which he is subjected, to urge upon him the dangers of soil-exhaustion from the loss of the elements of fertility in the products sold from the farm. Profitable farming can only be practiced when the surplus products of the farm can be disposed of at remunerative rates in the markets of the world; and these products must of course contain chemical constituents that might, under proper conditions, be looked upon as elements of fertility. But of what use are elements of fertility if they can not be converted into products that can be sold and made to contribute to the legitimate income that is the object of the farmer's labors? It is a false assumption in economic science that the sale of a product is to be deprecated as a positive loss to the means of production; but farmers are not alarmed by such sensational claims, as the fallacies of the proposition are readily detected.

American farmers will continue to sell grain and animal products of various forms as long as there is a demand for them outside of their farms, and this is of course the only available resource of profitable production; but they need not fear the evils of soil-exhaustion from this source, notwithstanding the warnings of alarmists who overlook the complex compensating agencies of Nature, and fail to recognize the real sources of diminished production. The history of agriculture and our knowledge of science agree in teaching that the causes of diminished productiveness that are often noticed and referred to as indications of soil-exhaustion, can not be exclusively attributed to the loss of constituents removed from the soil in the crops sold from the farm, but rather to the failure to conserve the available elements of fertility, and keep them in active circulation, by a judicious system of cropping and soil management.

If the fertilizing constituents of the barn-yard manure which are now wasted were utilized by being converted into farm products of marketable value, the gross agricultural exports of the United States might be more than doubled without making our soils appreciably poorer in any of their essential constituents.

It must be admitted, if the figures already given are approximately correct—and there is good reason to believe that they understate rather than exaggerate the real facts of the case—that the disposition made of the residues of the farm is of far greater importance in the farming of the future than the aggregate of soil constituents contained in the products exported.

Under the present conditions of production the problem for the farmer to solve is, How can the sale of farm products be increased without diminishing the productive resources of the farm? For many obvious reasons the purchase of commercial fertilizers can not be admitted as the constant factor required in

the solution of this problem. The profitable use of purchased manures must be limited to particular localities and special conditions of production, and they can not be made available to any extent as the staple source of fertility in general farm practice, as the markets of the world could supply the wants of but a very small proportion of the farms of the country.

Improved breeds of animals, and improved plants and seeds, in great variety, especially adapted to particular purposes, can now be obtained on every farm, and the rapid development of the mechanic arts has provided the most perfect implements and machines for economizing labor in every process. These lines of progress furnish important contributions to the means of profitable production, which the farmers of the country can not fail to appreciate. There remains, however, an extended field that is practically unworked, in which original investigations are needed to place our system of agriculture in full harmony with the requirements of the age.

From a practical standpoint, and as offering the most probable means of substantial progress, under present conditions of production, the subject of paramount importance to the farmer, and which should, therefore, receive a prominent place in a course of instruction in practical agriculture, is the utilization of farm residues of all kinds, with their available stores of the elements of fertility. Among these, barn-yard manure, from its obvious direct relations to the economics of production, should receive the share of attention its importance demands; but it must not, by any means, be looked upon as the only residue of the farm of economic interest. In a consistent system of practice, these residues must be made an efficient part of the circulating capital of the farm, and converted as rapidly as practicable, and with the least possible waste, into products of marketable value.

From the complex phenomena presented in the nutrition of plants and soil metabolism, the best methods for utilizing these residues can not be formulated in specific rules of practice that are of universal application. On every farm special conditions will be found which require intelligence and judgment in the application of general principles; and opportunities will be afforded, in each particular case, for the adjustment and balancing of the many contributions of science to meet the practical demands that arise from the varying combination of details presented in a wide range of topics, including the amelioration of soils by drainage and thorough tillage, the judicious arrangement of a succession of crops that will provide for a suitable supply of food for the animals of the farm, and the profitable appropriation of every element of fertility as soon as it is made available for the purposes of plant-growth; together with the economic conversion of

the vegetable products into marketable animal products, and the efficient distribution of the required labor throughout the year in accordance with strict business principles.

In order to realize the full benefits of efforts to improve the practice of agriculture in this direction, the increase and diffusion of knowledge relating to the applications of science in practice must be promoted and encouraged as an essential element of success. There has never been a time when the advantages of agricultural education were so clearly apparent, or the conditions of practice so favorable for the general recognition of the practical value of a knowledge of science.

Under this encouraging aspect of the times, the agricultural colleges of the country can now be made to command a dominant influence in developing an improved system of agriculture, by conducting their practical departments on a higher plane, that will fully supplement and emphasize the economic value of the class-room instruction in science, so that farmers may look to them with a reasonable expectation of obtaining the information needed in planning the best systems of practice.

A course of instruction in practical agriculture can not be consistently confined to the limited range of the established routine of farm-work, but it must be supplemented and widened by a full discussion of the applications of science in every process of the art, and the practicable means of making them available sources of profit. The labor system must likewise be made to contribute its share to the leading purpose, it should have in common with other departments, of developing in the student correct habits of observation and investigation, and he should be made to trace, in every detail of farm-work, illustrations of the principles taught in the class-room, so that he may acquire a proper appreciation of the intimate and legitimate relations of practice and science.

The sciences relating to agriculture have already made sufficient progress to place the leading principles of farm economy on a consistent basis, and they serve as a safe guide in tracing the lines of future progress, or the direction, at least, in which improvements in agriculture may be made; but there are, as yet, many unexplained details that need further experimental investigation. The invaluable experiments made at Rothamsted during the past forty years have fortunately laid the foundation of a consistent system for utilizing the residues of the farm; but it must be admitted that, aside from these admirable researches, there are few, if any, experiments on record that are of practical interest in this direction. The importance of additional experiments on the lines of investigation so successfully followed at Rothamsted can hardly be overestimated.

The annual preventable loss to the farmers of the United States of over $500,000,000 must serve to emphasize the advantages that may be derived from the thorough and systematic study of the economics of agriculture, and the pressing need of the increase and wider diffusion of knowledge in the domain of applied science. With clear and well-defined notions of the scope and essential factors of the required work, including an extended and accurate knowledge of science in its several departments, and an intimate acquaintance with the details of farm practice, a well-planned system of experiments, conducted with reasonable persistence and skill, can not fail to give results of great practical value to every farmer.

FALLACIES IN THE TRADES-UNIONS ARGUMENT.

By J. B. MANN.

THE errors which prevail in relation to certain foundation principles of the labor movement seem to justify an attempt to illustrate the subject, in a more commonplace way than is customary, by citations of such familiar incidents as meet the ordinary experience and thought of men in the common walks of life. The labor question is like any other, in respect to its dependence upon laws which can not be repealed by man or overthrown by organizations of classes or individuals. Everything in the world is subject to laws of its kind, from which there is no escape, whatever we may wish or attempt. Labor is no exception, and we must, therefore, ascertain what the laws pertaining to labor are, and then conduct the discussion in the light of them.

At the beginning, the most obvious thing concerning labor is, that it is a commodity. It is a thing bought and sold, and is of little value except under that condition. There is no such thing as society where labor is not bought, sold, or exchanged, and we can not conceive of a civilization which does not make labor a commodity and treat it as such.

The reason why another condition of things does not exist is, that natural law comes in and will not permit it. Man has need of very many things but he has time to acquire the skill to make only a few of them. He can learn and become expert in only one or two trades, and unless he is expert his trade will be of little use. The carpenter who builds but one house in his lifetime can not be much of an expert, especially if he has to raise his corn and potatoes, make his clothes, his tools, his household utensils, and whatever else is required while he is building the house. It would take a single man so long to learn the trades necessary to supply him-

self with comforts, that he would and could have no amount of comforts without a division of labor, under which each man should give his attention mainly to one thing, and that thing the one best suited to his faculty. Necessity, therefore, compels an exchange of labor, and thus labor becomes a commodity, and a thing of barter, transfer, and price.

The next important item in regard to the matter is that, to effect the exchange of labor, capital becomes a necessity also. A man chooses to be a farmer. He can do nothing at farming without a plow, a hoe, a shovel, and other tools, and these are capital. If he did not have the capital to buy them, he would have to make them, and have to learn how to make them, and have to dig the iron-ore, learn to smelt and prepare it, and work it, and learn to make the anvils and hammers, and nails, and screws, and all else used in the construction of a plow. But capital standing at the door with a plow ready made, the farmer can commence business the very day he gets title to his land.

These observations are elementary, it is true, but they are necessary as an introduction. They establish two points: First, that labor must be exchanged to be of any avail; and, second, it must be assisted by capital. It will be seen that the laborer must work along the line of diversity and development. Men instinctively do this generally in the beginnings of a community. One man becomes a blacksmith, one a carpenter, one a mason, one a shoemaker, and so on, in submission to the laws governing labor —the laws of diversity and development. They know, without argument, that two shoemakers and no blacksmith would be a foolish and unprofitable arrangement, and hence employments are divided spontaneously. As society advances, the occupations multiply; that is, they divide more and more, and by doing so each person has a chance to select the one which best suits his taste and capacity. And in this way the highest power of the community is developed. The best blacksmith takes the place of the bungler, the good workman in all branches finds employment, and the inexpert retires to some other calling, or perfects himself so as not to be driven to the wall. Society demands the best, and, as it advances, secures it more and more. The best tailor, and the best lecturer, and the best lawyer, are never idle; and they are produced by the law of diversity and development.

It is equally certain that capital is produced by labor, and is the natural result of labor husbanded and taken care of. The existence of capital is due to the previous existence of labor, but its existence in large quantity is due to the joint effort of labor and capital. The existence of the plow, which is capital, has kept the farmer from starving, and, as all other people depend upon the farmer for food, the plow has kept us all from starving. In the

same way the spindle and the loom have kept us from freezing; and they are capital.

To sum up this part of the case, we say that in order to have development we must have capital, that the amount of capital must depend upon the extent of development, and the amount of comfort attainable upon the union of capital and labor, working along the line of development. The man who can make two shoes in a day will supply double the needs of the shoe-wearing community that the man will who can make but one shoe in the same time, and, the world over, he will be pronounced the better man. Obviously, two things will certainly follow the introduction of such a workman: the community will get its shoes with one half the number of days' labor from the expert workman that were required when they were made by the inexpert workman, and it will have a citizen who will be accumulating capital, in lieu of one who could only barely make a living; for it will cost twice as much to clothe and feed the shoemaking force of a community when it takes twice the number of men to do the work, and, with double the expense, only half the capital can be accumulated.

Many years ago a distinguished philosopher and writer said that the man who could tell how to make two blades of grass grow where but one grew before, would be a great public benefactor. With two blades of grass on the average in lieu of one, we should have double the pork, beef, mutton, hides, wool, milk, butter, and cheese, and we could raise twice the corn, wheat, and potatoes; or, if these were not needed in such quantity, we would have to spend only half the time in meeting our wants. We all understand how it works. We know that a farmer who raises, year after year, but one ton of grass to the acre, is not only a poor farmer, but must be a poor man also, compared with the farmer who contrives to get two tons to the acre. We have all seen both kinds of farmers, and are all agreed as to their relative merits. The man who can accomplish most in the least time is unanimously regarded as the best man in every occupation of life in which he engages.

Universal opinion, therefore, establishes a goal for ambition, and men strive to reach it. We recognize success to be the goal, and success depends on the ability to do the most in the least time. We must work toward success; for working against success is sure to end in disaster. No man plants corn, and then, when the crop has been gathered, sets his granary on fire and burns it up. No man goes to his field and stands all day with folded arms, expecting that the crop will grow without planting and hoeing.

We have, then, a test by which to try all the plans which are projected to advance the interests of mankind, and it is so simple that any man of common understanding can apply it. Let us

apply it to some of the projects of the labor-reformers, using all candor and honesty. As I understand it, the trades-unions are conducted, so far as the members find it possible to conduct them, upon a theory exactly opposite to the universally recognized law of success. They make a regulation that no master-workman shall have more than a given number of apprentices. They say that no man shall work before a certain hour in the morning and after a certain hour in the evening. They provide that no man shall work for another who has treated a particular workman in a way not approved by the union. They require that, when one can not get a given price for labor, he shall cease work and remain idle. In some cases they contend that a good and specially effective hand shall have no better wages than an inferior and less effective one; and practically they strive to place a limit to the power of the community to provide for its support and comfort. The right to do all this I do not intend to discuss, but only its wisdom. Is it in the line of the conditions of success as we know them?

What makes a prosperous farmer? The answer is, industry, knowledge, adaptation of means to ends in such a way that the greatest crops shall be raised from the fewest acres. What makes a prosperous town or village? Evidently the development and judicious application of its forces to production in all departments. If we see a township with a hundred farms, and each farmer managing so that he secures only eight tons of hay from twelve acres, we shall find scraggy and lean cattle, small, inconvenient buildings, poor fences, and all the signs of unthrift, dilapidation, poverty, and decay. There is no doubt about it. Compare such a town with an adjoining one where by intelligence and active industry the farmers get twenty-five tons of hay from twelve acres. In the latter town will be found double the number of cattle, and more than double the number of the conveniences and comforts of life. The difference between two such towns is in what is termed accomplishment. That is to say, one town has shown what the result is from limiting its productions to less than one ton of grass per acre, and the other has shown how the face of things appears where all hands have tried to get two tons of grass per acre.

Now the same general result would follow were the main pursuit of the population mechanical instead of agricultural. Start the shoe business in two towns side by side, making the hours of labor six in one and twelve in the other, and in twenty-five years the latter town will be able to buy the former out four or five times. This, because the capital saved in the several years will have been earning all the time, while the other town will have used up all its earnings from year to year, and will stand at

the end of twenty-five years at the same point whence it started. In other words, limitation and curtailment of resources inevitably tend to poverty, and development and use of resources surely tend to prosperity and comfort. The limitations of the unions, all of them, are on the line of non-accomplishment, and are avowedly designed to hinder or check production. They are adopted on the theory that with less production wages will rise, and in the rise of wages the laborer will receive as much compensation for one day's labor as he otherwise would for two days' labor.

Under certain contingencies, and for a time as to some individuals, that may happen. In a temporary glut of the market, curtailment of production is found to be a remedy, or a partial one, for unduly low prices, but even then the laborer has to lose all of the time needed to free the market from the excess of goods. Labor as a whole gains nothing, but loses. The farmers who raise only half a crop to the acre do not find in the long run that they get as much money as their neighbors who raise a full crop, notwithstanding there are short periods when hay which ordinarily fetches twelve dollars per ton will bring twenty-five dollars. Nobody has ever seen a half-crop farmer permanently prosperous out of the resources of his farm, and nobody has seen general prosperity when half the laboring population was idle, or when the whole laboring population was idle half the time. It is impossible in the nature of things, because the rewards of labor all come from the productions of labor, and when less is produced there must necessarily be less to divide. The price of a ton of hay in the market may go up from ten dollars to twenty, but the laws of production and labor are not cheated, nevertheless; for the way has not yet been discovered by which the one ton will sustain the life of the ox and the horse as long as the two tons will; and in spite of the double price the reduction in quantity is a dead loss to somebody, and in the end comes out of the consumers of meat, who are all taxed in higher prices they have to pay.

The direct effect of less labor is fewer articles for use, comfort, and luxury. This is the avowed purpose of the unions in trying to compel all laborers to agree to a limit for the hours of labor. They propose to sustain prices by creating comparative scarcity of goods, and claim that thereby they can secure as many comforts as before with shorter hours of work. But how? If they work enough faster, so as to make as many goods in six hours as they before made in ten, they would save in hours, it is true, and get as many goods. But this is not the aim. No scarcity would be attained in that way, and consequently prices would not be raised; and the conditions of poverty and prosperity would remain precisely as they were. It would be simply a question whether it is better on the whole to work leisurely or in a hurry, and unions

are never formed on such a question as that, for the plain reason that it suits some temperaments to hurry and other temperaments not to hurry, and a change can not be effected by regulation. The main object is more compensation for the same or less service, and it is expected to come by causing a scarcity of products; that is, with less to divide, the share of each will be greater—a contradiction in terms, regarding the matter as a permanent condition.

Let us illustrate in another way. We ask, Has man been provided with a surplus of force, the exercise of which, in efforts to get a good living, operates to prevent him from getting a good living? If this be the case, a reduction of force must prove beneficial. Are laboring-men prepared to admit this? Would it promote wealth to have every able-bodied man lose one foot, so as to reduce the aggregate activity of the community one half? Would a community of one-armed men get a more comfortable living than a community of two-armed men? Do we find slow, sluggish, time-wasting, inactive, and unindustrious peoples getting ahead and living a more desirable life than the vigorous, pushing, and constantly employed peoples? Yet a reduction of force a fourth, a third, and even a half, it is asserted by some, will enable the users of force greatly to improve their circumstances.

If we produce less we shall have more, according to the theory which demands less production as a means of getting richer. According to this theory, the little busy bee which improves each shining hour, and gathers honey *all* the day, makes a grand mistake. It should adopt the eight-hour system—gather less honey, and have more leisure.

The question of hours of labor as affecting the health and the length of life and happiness of laborers is not under discussion here, but simply their bearings upon the financial status of the men who do the work of the world. The workers are aiming at an improvement of their finances and at the abolition of poverty, and it is important to know whether the means proposed are adequate to the end, and even whether they tend to improvement of pecuniary conditions. Under some circumstances and for short periods, in given cases, a shortening of hours of labor may not cause a decrease in compensation. For instance, a man with plenty of money, having made up his mind to build a fine house, may go on and build it, though he pay ten-hour wages for eight hours' work. A number of men may do the same thing, and the mechanics who are fortunate enough to be in their employ will not be losers in consequence. But these cases are the exception and not the rule. When it comes to the great body of men who would build, the higher cost operates as a prohibition to building, as thousands of men would be unable to build and pay thirty per

cent more for labor and for materials; consequently they would continue to live in their old houses, thus reducing the quantity of work to be obtained, thereby throwing hosts of workmen out of employment, and causing a surplus of labor to be offered in the market, to the depression of the wages of those mechanics who have a chance to work. Further than this, in the end, a scarcity of houses would ensue, causing an advance in rents, to the detriment of all workmen who do not own the dwellings they live in and must pay the advance in rents. The processes would be somewhat slow, and be combined with so many obscure influences, that men would hardly know of any change, but after a few years they would realize that somehow the number of people struggling for a bare living had in no wise diminished, and the hardness of their lot had been in no way ameliorated.

That laboring-men are gradually coming to see the truth in these things is seen in their changed views in relation to strikes. A few years ago prodigious efforts were made to get men to strike. It was a favorite remedy with the leaders, and large promises of grand results were made and believed in. The strike was formerly the favorite panacea for keeping up prices of labor, but to-day the long-headed and wise men in the labor movement advise a resort to it only in cases of great aggravation, and not then until after all other known remedies have proved ineffectual. This change in sentiment could not have happened if former strikes had met expectations. It is asserted by labor-men that there is more distress among them than at any former time, and the good old days of thirty and forty years ago, when strikes were almost unknown, are pointed at as the true contrast of the present. If strikes had measurably succeeded, there would have been no ground for the assertion, for success could be proved only by showing an improvement in the circumstances of the classes for whose benefit they were instituted. If compensation after a strike is no better than it was before, it can not be said that the strike succeeded in securing better compensation; and, on the other hand, if compensation has been improved, the assertion that harder times prevail now than formerly must be untrue, and there is no reason why laboring-men should not keep on striking.

But it is said, in reply to this, that strikes are not favored now because the poverty of the working-classes is so extreme that a portion will yield before the proper result can be attained. This is the undoubted fact, and it is one which settles the case against inaugurating strikes. Men can not succeed in anything where their means are inadequate; and so long as laborers are poor, they can no more cease work long enough to make goods scarce than they can build ships and go into the carrying-trade. The circumstance of poverty is fatal to the luxury of frequent strikes, and

the time lost in carrying them out so cripples the workmen that they fail of being a remedy for low prices of labor.

If we take two families in rather poor circumstances, and apply the principle of short hours of labor to one and not to the other, we can get a tolerably clear idea of its operation. The families consist, say, of the fathers and mothers and six young children each, all the children being too young to be of great assistance. Mrs. A rises at five in the morning, prepares breakfast, after breakfast clears off the table, washes the dishes, gets dinner and tea, clears up, at some time sweeps the rooms, sews a little, knits a little, mends and darns a little, and thus uses up nearly every moment of time until ten or eleven o'clock at night. Her house is kept in order and her children appear at school and church neatly clad, hold up their heads with a self-respecting air, and are able to associate with pupils quite superior to them in pecuniary circumstances; but it is due to sixteen hours of diligence and well-applied labor on the part of the mother. On the other hand, Mrs. B holds to the theory that eight hours of labor is enough, and puts it in practice. She omits the sweeping, and her house and furniture become untidy and unattractive. She omits the darning and mending, so that her children can not go to church, and go to school in rags, whereby they fall in standing and association, acquire the manners and morals of the neglected classes, and grow up cursing destiny and preparing to retaliate on society for having consigned them to a life of ignorance, want, and degradation. The contrast between the two families in the matters of comfort, morals, prospects, and happiness is striking. But contrasts of the kind are often seen; and it is generally recognized that the difference is owing to the unremitting fidelity and industry of the Mrs. A's as set off against the lax work of the Mrs. B's. Should Mrs. A shorten her hours of labor to eight, permanently, the family, instead of faring better, must inevitably fare worse; and what is true of one family is true of two, of twenty, of a hundred, and of all the community dependent on labor for support. This will remain true until the time comes when eight hours' labor will pay for the comforts now secured by twelve or fourteen hours' labor.

WHETHER superficial knowledge be beneficial or deleterious may depend on what is meant by the term. If we mean by it incorrect knowledge, that certainly is worse than no knowledge at all; if simply a small amount of knowledge, the least is of advantage. A little knowledge on a great many subjects, as Mr. Balfour has said in his rectorial address at St. Andrew's, will conduce more to happiness and enjoyment, and will better render a man's mind wide and liberal in tone, and free from the prejudices of ignorance, than a great deal of knowledge on one subject alone. The best condition is to know as much as possible on one subject, and cultivate a little knowledge on many others.

BOTANY AS IT MAY BE TAUGHT.

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AT the outset, let the reader's mind be free from any idea that the writer thinks he has found a new or royal road to botanical teaching, or that the method here to be stated is any panacea for the ills which follow as a natural result from the old stereotyped ideas of education. He presents it because it has borne good fruit, and combines some features which he has not known of having been dovetailed together elsewhere. This last reason may only give a wide exposure to his ignorance of the ways of botanical teachers. And yet the fault, if it is a fault, lies in part at the feet of his collaborators in natural history. The thought has often occurred to me that botanists do not say enough about their class-work. There is, of course, a strong incentive to let the labor with students be of secondary importance, and to bend all the energies toward some special end in systematic anatomical or physiological work, and thereby to feel that the space in the journals is only open to things new to science. A person, however, with large classes to carry, which consume the greater part of his time, often wishes that the periodicals contained more hints and suggestions as to the most approved methods of imparting knowledge in a branch of natural history which all advanced teachers agree is passing through the diseases and other dangers and trials incident to childhood. At the present time there are nearly as many ways of carrying a class through a course in botany as there are active teachers in the field. Some experienced teachers begin the study with the unicellular plants, and pass upward to the more complex structures. Others advocate opening the study with the kinds most easily found by the untrained eyes and best illustrating all the parts of a highly organized plant. Still others are quite indifferent to method, and consider the subject nearest at hand as the best to use. There are teachers who cling closely to some text-book, and measure their success by the same yard-stick used by the mathematician. Others go to the opposite extreme, discard all texts, and study only the things themselves. The great end in view in this last method is the teaching of the student to see for himself and to finally become an earnest, thoughtful, conscientious, and independent reader of the great open book of Nature. The writer confesses a strong feeling of preference toward this last view of instruction in botany. He would have his students see and think for themselves, and yet realize that others have gone over the same path and passed far beyond them in every branch of the road they are traveling.

No one but the teacher knows how hard it is to dispossess the minds of some students of the old inherited ideas of learning from books. They take as naturally to memorizing a page of text as young ducks to water. In fact, they come to us with no other ideas of education. Like many other mammalia, they are born blind—to the world of natural objects—and, worse than all, they learn to read before they acquire the power of sight. But, thanks to the Kindergarten system, object-teaching is coming slowly forward, and before many generations pass we may hope to have a natural method of education, because then the youth will have grown up under its vitalizing influence. Until then it may be that each teacher will strive to fit his abilities and notions to those of his pupils, and methods will vary and opinions widely differ. It seems all the more important that the ways and means of instruction should have a place in the journals which deal particularly with the subjects taught.

During the past two years the writer has attempted to lead large classes in the direction which it was hoped would develop individual research. The results have been sufficiently satisfactory to warrant a mention of the plan—not for its newness, but that it may draw out criticisms to be used in improving the method, and to suggest a similar trial by those who are similarly situated. The point, in short, of this paper is to show how a sophomore class of thirty-seven members, in an agricultural college, was, the past year, carried through a term of botany lasting seventeen weeks, and reaching from July 20th until near the middle of November. Three class-room exercises of an hour were held each week, and one afternoon weekly was spent in the botanical laboratory. The class had already taken one full year of botany, with recitation exercises occurring twice per week, and among other work each pupil had made a herbarium of fifty species, collected, pressed, mounted, and labeled by himself. The class was fully up to the average for colleges of this sort, in both years and ability, and contained fourteen ladies and twenty-three gentlemen. No text-book was used, and all formal lectures were dispensed with. The work assigned for the term was placed under five heads, namely: 1, herbarium; 2, economic subjects; 3, orders; 4, topics of research; 5, laboratory work. In the first place, fifty species, neatly mounted on standard herbarium paper, were added to the herbarium of the previous term. Each student in the lecture-room was assigned a chair with a broad table-arm for holding specimens, hand-lens, etc. During the first six weeks the class exercises were devoted to plant analyses. The specimens were collected in abundance by the students, in turn, and from three to five species were classified during the hour. Dried specimens of the several genera under consideration were brought

from the college herbarium, and, when a student had completed his determination, he was expected to make comparisons with the authentic herbarium specimens. At the end of the first half of the term each student submitted his collection, in portfolio, and about ten days after it was again brought for the examination. This was entirely oral, with the specimens before the student. Questions were rapidly asked upon a wide range of subjects and varying for different students. Ordinal characteristics, botanical names, habitats, striking peculiarities, comparison of species of same genus, contrasts of genera of different orders, are some of the groups into which the questions fell. About five pupils could be thus quizzed per hour.

If there should be any lack of specimens, owing to stormy weather, or spare moments from any cause, the economic subjects were resorted to for filling the hour. These subjects form the second feature of the work of the term, and were selected in order of importance, and assigned four to each student, who prepared for recitation upon them. Each set of four subjects was made to embrace as wide a range of vegetable products as possible. The following are two fair samples: Camphor, ebony, orange, and tomato; Brazil-nut, flax, opium, and turnip. These topics were looked up in the college library, using several books the titles of which had previously been placed upon the lecture-room blackboard as "books of reference." The value to students of learning how to use encyclopædias and other reference-books in work of this kind is almost as great as that of the actual information gained upon the subjects in hand. The students took full notes of the recitations upon the topics, and the questions for examination, following this work, were such as to require the grouping and classifying of subjects. A list of general questions was placed upon the blackboard many days before the examination, and from this set a number were finally selected as tests. As samples the following may be given: Treat of the leading commercial gums; the tropical fruits; plants grown for their roots; commercial spices; the leading drugs; Iowa's most important food-plants, etc.

Besides these economic subjects each student at the beginning of the term selected a natural order upon which to prepare, for the class, a paper of ten to fifteen minutes in length. The economic topics easily prepared the way for this more thorough work upon some particular group of plants. For example, the student who selected the pulse family (*Leguminosæ*) had the advantage of all the notes upon the various gums, drugs, dyestuffs, precious woods, food and fodder plants of the order. In like manner, the writer upon the grasses and grains (order *Gramineæ*) or the palm family (*Palmaceæ*), could use the information previously pre-

sented upon any economic subject in his respective group. Limited space prevents the reproduction here of even a part of a single paper, thus prepared, although the desire is strong to do it. Some students exhibited much originality in grouping the most important facts and followed up the work until all the sources of information were exhausted. The views of different authors concerning the relative position and "naturalness" of the orders frequently came up, and many important points in systematic botany appeared for consideration.

Some teachers may think too much time was given to this library-work. Let it be kept in mind that at this same time the field-work upon the collection was being prosecuted. During the afternoon a student may have searched in the field and forest for living spicemens, and the following evening hunted in the botanical alcove of the library for the facts concerning an economic topic, or collected notes for a paper upon a natural order. The work outside of the class-room and laboratory was a wholesome and healthful mixture of searching in the open air and among the library-books. The habit of looking up subjects in a list of authorities is exceedingly valuable, and one which many students, of themselves, never acquire. When at the same time they get information upon the most practical of subjects, a double purpose is served. A breadth of view of economic botany is thus obtained which does not come from conning a text-book or listening to a course of lectures.

Each student took full notes upon the orders as the papers were presented in class. At the close an examination was held, which consisted in writing upon six out of ten orders chosen by lot from the whole list. Each student, of course, omitted his own order if it chanced to be among those drawn.

In direct contrast with the work in the library was that upon the topics of research. These subjects were also given out at the beginning of the term, so that observations and experiments could be extended over fully three months of the growing season. This is the fourth branch of the term's work, and was designed to lead the students to become investigators in a small way, and learn to ask questions of and receive answers directly from Nature. How well this work was done can only be determined by a careful reading of the papers prepared under this head. It is impossible to more than indicate the results obtained. In the following notes the topics of research are given within quotation-marks: The student with "The Wild Plants of our (the college) Public Grounds" found one hundred and eight species in thirty-four orders. The paper gave the number in each order; those which were herbs, shrubs, or trees, etc. For example, there were twenty-seven compositæ, ten polygonaceæ, five cruciferæ, ten families with two

species each, and thirteen orders with each a single representative. Sixteen were not indigenous. Observations in all intensities of light and darkness led to a paper upon the "Sleep of Plants." The honey-locust proved a good subject for observation upon these nyctitropic or sleep movements. Two papers were upon the germination of seeds. In one those of pumpkins and beans were selected, and in the other corn and peas. These seeds were planted by the students in deep dishes and placed in their windows. A careful record of daily observations and measurements was kept, the idea being for the students to learn how to conduct careful experiments. A large area on the blackboard, covered with neat drawings of young plants in all stages of germination, illustrated this work to the other members of the class. The student with "Plants having Two Kinds of Flowers" first worked independent of any guide, and finally closed his studies with a review of Darwin's book upon this subject, a summary of which was presented to the class. Sufficient study had been given to the subject to greatly increase the interest in the book, and the student volunteered the remark that it was exceedingly valuable reading. The "Flora of the Dry Beds of Streams" was exceptional, because the season had been one of extreme drought. Fifty species were found, and three fourths were plants common to low ground. Many species of the remaining one fourth were found elsewhere on gravelly banks. A few were water-plants which continued to survive. Twenty-two orders and thirty-eight genera were represented. Two topics in difficult systematic work were assigned, namely, to one student "The Solidagos," and to another "The Asters." A key was formed for the rapid determination of the local representatives of these two genera. Good herbarium specimens were prepared of the various species and submitted to the class. We have thirteen species of solidagos, and, of the one hundred and fifty asters in the United States, Iowa has twenty-four, fourteen of which are found in the vicinity of the college.

Several of the topics required microscopic work, and the students with these spent extra time in the laboratory. A microscopic study of "Terminal Buds" revealed the whole plan of a year's growth in such buds as those of the horse-chestnut, where flowers in miniature were so numerous that forty could be counted in a single longitudinal section. "Plant-Hairs" was a subject worked almost entirely in the laboratory. A division was first made into those consisting of a single cell and those with more than one. For convenience of further study the subject was again divided into the hairs of flowers, of leaves, of stems, and of roots. The "Seeds of Cruciferous Plants" furnished the pupil subjects for a study into the minute points of classification in the ordinal key of this very natural order, especially as regards accumbent, incumbent,

and conduplicate embryos. The student in charge of "Abnormal Forms in Plants" was able to report a number of monstrosities. All members of the class were expected to contribute, if possible, to this paper upon teratology. A toad-flax (*Linaria vulgaris*) flower with five spurs instead of one was found; two blossoms of an onosmodium were united into one; a spike of foxtail (*Setaria viridis*) was divided into seven prongs, and perhaps the most interesting was the finding of many pistils of prairie pink (*Phlox pilosa*) in which there were four cavities instead of three, the normal number. The ovaries for the whole order *Polemoniaceæ*, to which the phlox belongs, are tricarpellary, and therefore this is a variation which affects the ordinal description. Under the "Dehiscence of Fruits" the pods and capsules of various plants were studied, including those of impatiens, milkweed, violet, and poppy. Observations were made upon the "sensitive stigmas" of the trumpet creeper (*Tecoma radicans*), which were found to close in one minute when most active—that is, with freshly opened flowers on a bright, hot day. The "Insects Injurious to Plants" furnished abundance of material for an extended paper, and the investigation of the "Root-System of Corn" enabled a student agriculturally inclined to become familiar, by spade and shovel, with the manner in which the roots of our leading crop are spread in the soil. A contrast between "Grape and Cucumber Tendrils" and a study of "How the Virginia Creeper Creeps" were two subjects which, when specially investigated, enabled the students to become familiar with a number of questions which are not easily answered by a study of books. The "Stipules of Various Plants," when contrasted by making drawings of the living specimens, made a paper of interest to all. The clovers and docks were investigated in particular. The leaf-type of the great rag-weed (*Ambrosia trifida*) was worked out after an examination of two thousand leaves. An opportunity for some thorough microscopic work was offered in the "Pollen of Ten Kinds of Flowers," and it brought out the difference existing in pollen of the same species as well as contrasts between the fertilizing dust of widely separated orders. "Thickness of Leaves" and the "Polarity in the Compass-Plant" were two topics varying widely in their treatment, one being a general and the other a special topic upon foliage. The "Time required for the Ripening of Seed" was determined in an experimental way. Blossoms of various plants were marked with twine and watched until seeds from them matured. Common purslane required ten days; the cultivated species of the same genus, (*Portulacca grandiflora*) needed fifteen days, while three times as long was insufficient time for maturing the seeds of *Euphorbia hypericæfolia*. "The Number of Seeds upon Three Kinds of Weeds" was determined as follows: common dock, 7,556;

black mustard, 16,416; and burdock, 36,456. The plants chosen were all average ones. A "Flora of a Stubble-Field" was that of a few acres where oats had grown. The *Compositæ* and *Gramineæ* orders were represented by the largest number of species, and furnished by far the greatest percentage of specimens. Two species of rag-weed and the foxtail grass covered four fifths of the field. However, thirty-five species in sixteen orders were represented. Many of these matured their seeds before September 17th, and nearly all before October 10th. Leaves of young, rapidly growing shoots were compared with those of slow-growing branches of old trees, and gave a good idea of the variability of foliage within the same species, or even the same shrub or tree. "Unequal-lobed Leaves" furnished a topic for the study of seeming irregularity, which is, however, a comparatively constant peculiarity in some species. The time of "Opening and Closing of Flowers"; "Dispersion of Seeds, a Comparative Study of Two Labiate Flowers"; "Five Largest Wild Flowers," "Are our Weeds mostly Annuals?" "Anatomy of the Milkweed (*Asclepias*) Flower," and "Sensitive Stamens of Purslane," are other topics studied by the class, the results of which were none the less interesting because the length of this paper forbids particular mention of each.

To hold each student to an examination upon the work of all these topics of research was not feasible, therefore the notes taken by each member of the class upon the reports of all others were inspected. This secured a record for each student of all the important features brought out under the topics of research, and also furnished a basis for a class-mark as required by college law.

The closing exercise of the term was upon anatomy. A brief outline of the work done in the laboratory is given below. In way of preface it should be said that the students were entirely unacquainted with the compound microscope at the beginning of the term. The first day was spent in learning how to manipulate the instrument, cut thin sections, etc. The brittle stems of the common purslane are excellent for beginners to practice upon with the razor or scalpel. For the second day pollen of several kinds was studied, and ovaries in transverse and longitudinal sections. Accurate drawings are required of all prescribed work. The flower of the large thistle (*Cnicus altissimus*) filled the third afternoon. On the fourth day the stem of richweed (*Pilea pumila*) was studied. This subject is highly recommended to all instructors in vegetable anatomy who have not tried it. The course of each bundle is clearly seen from the outside of the comparatively transparent succulent stem. The duckweed (*Lemna*) is excellent for small roots and prominent root-caps, and the hairs of the squash illustrate living cells, with nucleus, nucleolus, and circulation of protoplasm. Following these, a comparative study was

made of the epidermis, including stomata of leaves of cabbage, corn, lilac, pine, and barberry. Next were studied the root-hairs on seedling clover and the stalked glands of the cup of the cup-plant (*Silphium perfoliatum*). Internal structure of leaf of stone-crop, lilac, and compass-plant were compared, followed by stem of purslane and maple (one and two years old); pine-wood, medullary rays; endogenous stem of asparagus and young corn, crystals; starch, cork, latex tubes, sieve-cells, and the mucilaginous modification of cell-walls as seen in the outer coat of the flaxseed.

This term is followed by another devoted to laboratory work of a more advanced sort, along with a course of lectures upon cryptogamic botany and vegetable physiology.

The old and, at one time, half-true belief that botany is a simple, useless, frivolous study of blossoms which the simpering girls at fashionable seminaries may be excused for calling a branch of learning, is fast passing away. It is a hopeful sign that even so plain-thinking and practical a class as our best farmers are beginning to realize that it is a pecuniary advantage to know more concerning the structure and habits of their farm-crops. They feel that there are laws which govern the improvement of their grains and fruits as well as of their cattle and sheep. In short, there is a demand for thorough instruction in all that pertains to plant-life, and the question naturally arises in the mind of the teacher, What is the best method of meeting the call made upon him for more light? Whatever the best way may be, it is hoped that the outline herein given approaches a method, pointing in the right direction—one which stimulates to deeper and more independent thought, and begets a spirit of respect for the minutest thing, and a burning love to know the truth as it is revealed in the endless book of Nature.

ARCTIC ALASKA.

By W. L. HOWARD,
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IN 1882 Congress appropriated money to buy presents for the purpose of rewarding the natives of St. Lawrence Bay, northeastern Siberia. These people had been very kind to the officers and men of the United States relief-ship Rodgers, burned in that bay November, 1881, while in search of the ill-fated Jeannette, having fed and partly clothed them through a severe arctic winter. Lieutenant George M. Stoney, United States Navy, one of the officers of the Rodgers, was detailed to make the presents, and in May, 1883, took passage in the revenue-cutter Corwin with

the gifts on board. The following July they were distributed from that vessel. Continuing on her cruise, the Corwin arrived in Kotzebue Sound, northwestern Alaska. Hearing through the Indians of a great stream emptying into Hotham Inlet, Lieutenant Stoney spent two weeks in searching for this river, and ascended it far enough to ascertain that it was a stream of considerable magnitude. Upon his return, he reported his discovery to the Secretary of the Navy, and requested leave to continue its exploration. The following spring a small party, with Lieutenant Stoney in command, was sent to survey this river. They succeeded in ascending about four hundred miles, when they were obliged to return, owing to the shortness of the season.

In the spring of 1885, a fully organized and equipped expedition left San Francisco, for the purpose of completing the survey of this river and exploring northern Alaska. The party was composed of Lieutenant George M. Stoney, in command; Ensigns J. L. Purcell, M. L. Read, W. L. Howard; Past Assistant Engineer A. V. Zane; Past Assistant Surgeon F. S. Nash, and ten picked men. A vessel was chartered to land the party, with provisions for two years, at Hotham Inlet. The expedition sailed May 3d, and reached the inlet July 12th, where everything was safely landed, and the vessel returned. A small stern-wheel steamer had been built in San Francisco, and carried on the schooner's deck, together with a powerful steam-launch. These were to be used in transporting the party and outfit up the river. Half of the provisions were *cached* or buried at the landing-point. Only a winter's supply was carried up the river.

The boats were loaded and started up the river, leaving half of the party at the landing-point. At night the boats were secured to the river's bank, and wood was cut for the next day's run. After ascending one hundred miles, the advance party encamped and the boats returned, bringing up more stores and the remainder of the party. In this way the river was ascended three hundred miles, when the winter-quarters were established. A large log-house was built, and around it the dirt was piled to the eaves. Inside, the house was partitioned off, lined with painted canvas, and the floors covered with bear-skins. The steamer's smoke-pipe was used for a chimney. With three wood-burning stoves, there was never any difficulty in keeping the house warm, even at the lowest temperature, 70° below zero (Fahr.).

During all this time we were materially assisted by the natives, a number of whom followed up the river and built their winter huts near. They appeared very friendly and pleased with us. During the month of September a trip was made to the neighboring mountains. The party, consisting of two white men and three Indians, left in a large skin-boat, taking five dogs and pro-

visions for ten days. The dogs were for the purpose of tracking, the Indian method of traveling in summer, and the only way the river can be ascended, on account of its rapid current. In tracking, the dogs are made to pull the boat by means of a long line, one end of which is secured to the boat and the other to the dogs' harness. The dogs trot along the bank, the boat being kept in the stream by a paddle astern. When the bank becomes impassable, they are taken into the boat and paddled to the other shore. After tracking two days, my companion and myself secured two natives as guides, and, leaving the river, set off for the mountains. At the end of the first day's tramp we sighted a black bear feeding upon berries about a mile distant. We were both so exhausted from our tiresome walk across the *tundra*, that we concluded to send one of the guides after the bear.

The Indian first seated himself and examined his rifle, selecting three cartridges and placing them in the gun. He then pulled a few hairs from his clothing, which he threw into the air to ascertain the direction of the wind, and then started so as to come up to leeward of the bear. We kept careful watch through a glass, and saw him on hands and knees work slowly toward the animal. When within one hundred and fifty yards, he fired two shots. The bear jumped and fell almost in his tracks.

There are probably no more superstitious people in the world than the northern Alaska Indians. Every action of their daily life is governed by some belief handed down from father to son, or originated by the *shaman*, the Indian doctor, who holds great sway over them. The ceremonies attending the killing of the bear will illustrate. Bruin was first placed upon his back, with the head toward the mountains. The head was then skinned, severed from the body, and taken by one of the natives who, placing himself astride of the dead animal, raised and lowered the head three times, touching the bear just over the heart each time, and muttering some incantation. The third time he threw it from him, uttering a loud shout, in which the other natives joined. This was done to drive the bear's spirit to the mountains, so that it would cause them no future trouble. A part of the dead animal had to be left on the spot where he was killed, or the hunters would get no deer that season. A camp was made at the place, and after the head had been roasted and picked clean it was placed in the top of a high tree, but for what purpose they would not tell. The skin was stretched flat upon the *tundra*—fur-side down. The portion of the bear not consumed was placed in a tree and a rude scarecrow made to keep away birds. The following winter the skin and meat were sledged for and found in good condition.

While tracking along the river, numbers of dead salmon were

noticed. A great many were also seen swimming sluggishly upon the surface of the water, with their dorsal fins well out, and apparently little life left. Their fins and tails all presented a stringy appearance, and were sloughing off. The natives say that these fish ascend the river but never go down; they go to the head-waters, spawn, and swim ashore to die. In our own experience, the salmon were constantly ascending the river; the later the season, the higher up they were found, and none were known to pass down. In the spring the young salmon go down and out to sea.

The valley of the Coobuck or Putnam River is about thirty miles in width. For half a mile on either bank is a heavy growth of spruce, cottonwood, and birch trees. Between this and the mountains is rolling tundra-land. The first forty-five miles of the river from the coast is the delta, with numerous lakes and marshes of various sizes, all connected by small streams, running in every direction, and communicating with numerous arms leading to the main stream. Most of the channels are too intricate to be followed. There are thirteen mouths to the river; the smallest and shoalest empties into Selewik Lake; all the others empty into Hotham Inlet. The main and most easily navigated entrance lies about one mile west of Selewik Lake. It is about fifty yards wide with twelve feet of water on the bar. Seven miles from this entrance it is eleven hundred yards wide and thirty feet deep; forty miles beyond it leads into the river proper.

The general direction of the river is westward. Its width varies from fifty to twelve hundred yards, according to the nature of the country. It is extremely tortuous, and at no place can be seen a straight course of two miles. Traces in the valley show that it has often changed its course. The current varies from three to five miles, according to the width and height of the river. Near the head-waters are rapids. The banks in places rise so gradually as to be barely noticeable, while in other places are foot-hills one hundred and fifty feet high. The river is filled with islands and has numerous tributaries.

The river freezes in October and opens in June. During the month of February the maximum thickness of ice made in twenty-four hours was four inches; the minimum, one half inch; and for the month, six feet. There is a hot spring near the river's bank about four hundred miles from its mouth. This was visited in midwinter, and its temperature found to be 100° above zero, the temperature of the surrounding atmosphere being 50° below zero. The natives state that it is so hot at times that meat can be cooked in it.

Winter is the only season in which one can travel in the interior of northern Alaska. The marshy *tundra* is then frozen and covered with snow, making it possible to cross. The natives kill

their game and do their hunting and trapping during this season. In the summer they descend the rivers to the coast for the purpose of meeting the whalers and traders, and bartering the furs caught during the winter. The principal furs of the interior are the black and silver-gray fox-skins, black and brown bear, wolf, lynx, beaver, otter, and numerous smaller skins, as marten, ermine, etc. For these skins the Indians receive in exchange powder and lead, tobacco, cotton drilling, and various small articles. Rifles are highly prized, and, although they are contraband, nearly every Indian possesses one. Deer are caught in great numbers, but their skins are valuable only among the natives for clothing.

A deer-hunt which we witnessed was so different from our previous conceptions that I think it worthy a description. Upon this occasion, while sledging with a party of Indians, a herd of deer was sighted. The natives took their rifles and started, some going in one direction and some in another, but all keeping to leeward of the deer. Those who went directly toward the herd waited until the others had got partly around before starting. The first shot was the signal, whereupon all hands rushed toward the frightened animals, who separated and plunged blindly in every direction. The Indians shouted, making all the noise possible, the fleeing animals in their fear mistaking Indians for deer, and rushing on until a shot showed them their error, when they would turn and flee as blindly as before. Even after the first fright they circled around the danger, trying to get together, and in this way many more were killed. As much meat as could be carried was loaded upon the sleds, while the remainder was *cached* in the snow, to be sledged for at some future time.

The Indians spend their winters in the mountains. They are generally found in villages consisting of from two to a dozen houses. The winter house of these people consists of a hemispherically shaped hut, made by bending willow saplings or cutting spruce to the desired shape. The framework is covered with brush, and over this dried moss and turf to the depth of a foot or more. There is an ice-window on either side of the entrance. In the roof is a hole just over the fireplace for the smoke. Inside, the center of the hut is used as the fireplace, the fire being made the same as in the open air. At the back of the hut is a meat-stand, upon which several hundred pounds of deer-meat are kept, so that a quantity will be on hand sufficiently thawed for use. Upon entering a hut when traveling, some of this partially thawed meat is always offered to the new-comer. The floor of the hut is covered with brush, upon which they sit during the day, and spread skins to sleep upon at night. Meat is cooked but once a day. About 5 P. M. a large fire is started and the pots are put on. These are the ordinary kettles of civilization which they get in trade, or, in

their absence, pots made of native clay are used The cooking is done by the women, who taste the meat from the moment it is put on the fire until cooked. The remainder of the fire is then thrown out through the hole in the roof by the young men, and, as soon as the hut is clear of smoke, the flap that covers the chimney-hole is hauled over for the night. The hunters return usually about this time of the day, and upon entering the hut take off most of their clothes. After eating pounds of the deer-meat, alternating the cooked with raw meat, and drinking quantities of the soup, they smoke a pipe, and all hands go to sleep. All the household are fond of stripping and baking themselves before the fire, particularly the old people, who go so close as to almost blister themselves. They say the heat makes them young, and drives away their pains.

The deer are not usually hunted as in the manner just described, but are killed in the following fashion: For miles before arriving at a village, long rows of stakes were noticed stuck in the snow. They consisted of bushes about six feet high, and were placed about fifty feet apart. Against the white background they give the appearance of a man. Two lines of these bushes are made, their outer extremities a mile apart. The lines gradually converge, so as to form a lane. At the end of this lane is a corral, built of brush and wood, through which a deer can not penetrate. The brush is hung with nooses to catch the animals should they attempt to pierce the confines. A herd of deer being sighted, they are driven by the natives toward the entrance of this trap. The deer flee from one side of the lane to the other, mistaking the bushes for men, and finally enter the corral, where they are killed with bow and arrow. Hundreds are killed every season in these traps.

The first of December, as there was then plenty of snow on the ground, the sledging-trips commenced. I had looked forward to them, anticipating a great deal of pleasure. My idea of sledging was based upon a half-forgotten picture in an old school atlas, representing a man dressed in furs comfortably seated upon a sled, brandishing a long whip over six dogs in front, all on a trot.

The first thing to be considered upon preparing for a sledging-trip is the question of provisions—for both party and dogs—cooking-utensils, clothing, tent, and numerous smaller articles, until the prospect of comfortably tucking one's self in a robe on the sled looks very much like riding upon the hump of a camel. At least two persons are necessary in the management of a sled: one to run ahead for the dogs to follow, and the other to remain with and guide the vehicle. The dogs will follow a beaten path, but in crossing the trackless country it is always necessary to have a runner ahead. The sleds were loaded so heavily that all thought of rid-

ing was given up, and in less than a mile from the starting-point all hands were upon snow-shoes. These shoes are from three to five feet in length, bowed and curved upward at the toes, and tapering to a point behind. In the center are thongs upon which the foot rests. They are secured to the feet by two thongs crossing just forward of the instep, passing around the heel, and attached to the shoe near the toes. This gives the foot full play, and enables one to rise upon the ball of the foot, as in walking, and shove the shoe forward over the snow instead of lifting it. It is very easy to walk a short distance, but, when running after a sled over the uneven country, the tendency of the shoes to rise is equal to that of a pair of roller-skates upon the feet of a novice.

The first sledging-trip was to the northward. At 4 P. M., after a hard day's march, a camp was established, it being then too dark to travel. The dogs are first unharnessed, and chained separately to bushes, to prevent fighting. After an hour's rest they are fed upon dried fish, this being the only meal they receive in twenty-four hours. They are given all they can eat unless the supply is short, and in such cases their endurance is wonderful, a small piece of fish once a day sufficing a dog and enabling him to work for a couple of weeks. A great many interesting facts could be given illustrating the sagacity and endurance of these animals. As a rule, they have no affection. They recognize the person who feeds them as their master, but they obey only through fear. They are more than half wolf, as all young wolves caught are raised and used as dogs. In every team there is generally one dog who constitutes himself master. He is naturally one of the most powerful of the number, and the others seem to recognize his supremacy. This dog, upon seeing any one of the others habitually shirking while the rest are pulling, will attempt to reach and punish him, and if it is impossible to do so while in harness, will deliberately go to him when the day's sledging is finished and administer the deserved chastisement.

In establishing a night-camp when in a wooded country, the most sheltered spot is selected and a pit is dug in the snow about fifteen feet in diameter and a foot deep. The bottom is then stamped down to make a hard floor. Around this pit is built a wall about four feet high, by laying young spruce-trees on top of one another and cutting off their inside branches. This wall has two openings or breaks diametrically opposed, dividing the pit into halves with a through passage-way separating them. Along this way, which must always face the wind, dried wood is piled and fired. On either side pine-boughs are laid on the snow, and on top of them the sleeping-bags. Such night-camps are easily made, and the coldest nights can be comfortably passed in them. The only drawback is the difficulty in getting wood.

After a nine days' trip the village of Nimyuk, the highest settlement on the "No Talk" or Inland River, was reached. This village consisted of four huts, containing thirty inhabitants. They subsist almost exclusively upon deer-meat, of which they had at least two thousand pounds on hand. The day of our arrival thirteen deer were killed, and in some of the *caches* were as many as thirty. We were greatly annoyed by the curiosity of these people, some of whom had never seen white men before, and by their superstitions. As it was their dancing season, no meat could be cut with an axe, and we were compelled to saw up a frozen deer —a difficult task. Neither could any meat be cooked in the house nor tea drawn. The work had to be done outside, and the things passed through the chimney-hole. These fancies are persisted in, in the belief that to do otherwise would drive the deer from the mountains. In some instances their superstitions can be overcome by the payment of a bribe.

On the 12th of April the writer of this article started on a trip across the country, the object being to reach the arctic coast if possible, and thus penetrate a portion of the Territory never crossed before. Previous to this I had made two trips one hundred miles to the northward, and *cached* dog-food for use on the final journey. I took with me at starting one white man, two Indians, fifteen dogs, and two sleds, and all the provisions the sleds could carry. The snow had commenced melting at midday, but at midnight the temperature fell as low as 25° below zero. A week's travel brought me to the village whose inhabitants make the trip to the arctic coast. As I intended journeying with these natives, one sled and the two Indians were sent back to the winter station. Many attempts were made during the winter to induce these people to cross this northern region, but they could not be tempted, saying it was impossible on account of the cold and scarcity of food. Northern Alaska can only be crossed at two seasons of the year: in the spring just before the rivers break up, and in the fall just as they close. The deer leave the mountains at these seasons and cross, thus settling the question of food. A few of the most interesting facts observed upon this trip are briefly related, as follows:

On May 1st twenty sleds left the village in the mountains on their annual visit to the coast. This caravan, stretching out over half a mile of country, presented a peculiar spectacle, men, women, children, and dogs all pulling at sleds. When an Indian travels he carries all his possessions with him. Everybody was upon snow-shoes, and numerous stops had to be made to allow the old people to catch up. During this trip an addition was made to the party in the person of a baby boy born on the march. One noon, while the caravan halted, some Indians hollowed a shelter out of a

snow-drift, and put in a couple of deer-skins. The sleds then started on, leaving the prospective mother behind alone. That evening the mother and child came into camp, the woman having given birth to the child and walked several miles. While traveling the next day the woman had hard work keeping up, and, upon passing her as she rested in the snow, I offered her a seat upon my sled, but the others would not allow her to ride. Also, in cooking, she was compelled to make her own fire and cook alone, for she could not drink from the same cup as the others; and there were numerous other absurdities. According to their superstitions, the non-observance of these customs would result in misfortune to the child.

After a week's hard sledging the head-waters of the Kunyanook or Colville River were reached. Here all hands encamped near the site of an old village, and preparations were made for spending several days. Part of the caravan were to remain at this place until the river broke up, and then make the remainder of the distance in boats. This point was the highest on the river that the natives could reach in boats. They ascend here in the fall and wait for the snow to come to enable them to sledge to the mountains. The boats are stripped, the skins which form their covering being buried until the next season, and the frames placed high up on racks to prevent wild animals from reaching them and eating the lashings. In the spring they sledge from the mountains to the boats, where they wait for the river to break up and thence descend to the coast. This practice is general with all the interior natives.

After resting three days at this village the journey was resumed, only six sleds going on. The Indians told of another river farther to the westward, and I concluded to accompany them to find this new river. After sledging upon the Colville six days, that river was left, and a range of hills about five hundred feet high crossed, bringing us to the Ik-pik-puk, the Indian name of the new river. These hills form the northern limit of the mountains of Alaska. On one side is the Colville, which here makes a sudden bend to the eastward; on the other the Ik-pik-puk finds its head-waters. Proceeding farther north, the country gradually becomes more and more level, until, for the last fifty miles from the arctic coast, it is perfectly flat, with no elevation, and is so full of lakes, marshes, and rivers that it is impossible to walk any distance in a given direction. In crossing this section we could gather no fuel of any kind, and our food had to be eaten uncooked; but this fact did not trouble the natives. The greater part of the time we had no food, and our diet consisted mainly of a succulent root growing in the marshes, which the natives gather in quantities, depending upon it when other resources fail.

A camp was made at the head-waters of the Ik-pik-puk, and runners were sent ahead to the village below to announce our arrival—this being the usual custom. Early the next morning dogs came to help our worn-out animals, and at noon we reached the village, where one hundred and fifty Indians were encamped waiting for the river to break up. We had evidently been expected—a place having been reserved for us—and while the new-comers rested, the women unharnessed and fed the dogs, pitched our tents, and prepared food. In the center of the village was a great dance-house, where the men gathered to work during the day, and dance at night. They are very fond of this amusement, sometimes continuing it the night through. Some of the dances are pretty, the motions being graceful, but they soon become monotonous. The music is produced by from four to ten "tom-toms," upon which they beat time, while shouting at the top of their voices a rude monotone. Men, women, and children all dance—often continuing until they drop from exhaustion. The first things taught children are to dance, shoot the bow and arrow, and to smoke. It is a common occurrence to see a mother take the child from her breast and give it her pipe.

At this time—the last of May—we had quantities of berries. They had ripened during the last season; the snow had preserved them through the winter, and was now melting sufficiently to expose the bushes. While waiting for the river to break up, the men busied themselves in repairing the old and making new boat-frames. Their boats are of two kinds: the *kayak*, or one-man boat, and the *oomiak*, a large boat capable of carrying a ton. The frames for these boats are whittled entirely by hand. After they are thus made and fitted, they are securely lashed with whalebone strips, and are then ready for their covers. The *oomiaks* are covered with seal or walrus skins, five to seven of which form a cover. The *kayaks* are covered with deer-skin, the skins being first soaked and scraped. These covers, which had been *cached* all winter, were now taken out and buried beneath the melting snow, to render them soft and pliable.

The women were busy currying deer-skins for clothing, and making twine for fish-nets. The native tanning consists of scraping the dried skin thoroughly with an instrument made by putting a piece of flint-rock in a wooden handle, so curved as to fit the hand perfectly. The stone is chipped at one end, so as to make a rough, sharp edge. After scraping, it is rubbed with a soft stone resembling pumice, which whitens and softens it. The finished skin looks and feels like chamois. The twine with which they sew is made from the sinews of the deer, which are dried and torn in shreds, and these are twisted together, making a very strong cord. This is used for making nets also, any required strength

being given by using larger shreds. The only disadvantage in using it is, that the nets and lines must be taken from the water and dried frequently to prevent rotting. A stout line is made by cutting a deer-skin in one continuous strip, about one quarter-inch wide. The stoutest line—used in tracking—is made in the same way from walrus-hide.

The river broke up June 3d, and on the 8th five *oomiaks* left the village. After an interval of two days, five more left, and so on, the country not furnishing enough food for all to go in a body. June 27th the arctic coast was reached. The river proved to be about two hundred and fifty miles in length, and enters the Arctic Ocean about forty miles to the eastward of Point Barrow. While floating this distance, I procured two mammoth-tusks, weighing about one hundred and fifty pounds each, and twelve feet in length. Every spring the river rises and washes away the icy earth forming its banks, thus exposing fresh surface. These tusks are found firmly imbedded in the ice. Three of them were exposed that season.

I was detained on the arctic coast from June 27th to July 16th, waiting for the ice to break up sufficiently to enable us to make our way inside of the heavy ice to Point Barrow. The northern shore of Alaska is extremely shallow and sandy, great sand-spits being shoved up by the ice all along the coast. The beach is covered with drift-wood, which comes from the rivers emptying into Behring Sea. In conclusion, the Indians of Alaska have been reported as savage and treacherous. In my experience, I found the natives of interior northern Alaska the most kind and hospitable people in the world.

MANUAL OR INDUSTRIAL TRAINING.

By Prof. G. VON TAUBE.

CIVILIZATION means economical foresight and the gradual subserviency of present selfish interests to the good of others in the future. True civilization begins only, then, when a new potential factor is recognized as worth striving for, to wit, the coming race and its future welfare. Emotionally we revive in our children; economically we sacrifice many of our present gratifications to the development of the race. True educational striving aims beyond the narrow view of the future career of a few beloved ones; it recognizes in the school-bench an economical measure of social security more powerful and efficient than drilled regiments, squads of policemen—yea, than well-organized dispensations of charity. True educational measures, therefore, grow

with us in their every-day importance; and their power of molding social conditions once recognized, the very important query may be considered if they could not be possibly so improved as to secure to the average individual means of subsistence outside of his general culture and the acknowledged moral improvement resulting from it.

Adaptation of general training to the presumable needs and wants of the individual, rather than to his social requirements, is the programme of the new education that has already modified the old-school routine through the introduction of the psychological basis, and which now proposes manual training as one more step forward. Tried on purely empirical bases, many inductions have been arrived at; still, a general deduction is yet wanted, before the measure proposed would be worthy of a true pedagogical interest.

The pleas for manual training as an educational measure are many, and as the methods employed in instruction must necessarily depend upon the end expected, it may not be amiss to examine at least the leading theories.

Such a critique, nevertheless, based upon the campaign words, if we may so call them, of the different advocates, in the absence of a full exposition of their views, must be made rather in the form of suggestion than otherwise. Thus, the first purpose encountered is that of the *development of perceptions.* One would assume a psychological basis, if the age of the pupil corresponded with the programme in view; but in the present application perceptions mean sharpness of the sensorium, the first stage of mental growth in the child, generally expected to have been accomplished in the Kindergarten; afterward objective teaching in the elements of natural sciences, aided by collections, etc., would do just as well, and, moreover, would produce as a beneficial result certain general knowledge not obtainable from the simple manipulation of tools.

2. "The use of the hand and brain" is a general figure that is certain to be found on every page treating of industrial training. It would do very well indeed if the brains were necessarily taken into co-operation; but such a general programme depends too much upon the system employed. It will be found entirely unsatisfactory if the means applied be confined to a so-called series of graded exercises in wood or metal work — say cross-cut, rip-saw, nailing, gauging, squaring, etc.—followed, as they generally are, by the x y number of joints about the practical use of which the pupil generally remains in the dark. Brains, if considered independently from their owner, are too apt to be subject to the general law of inertia, and the whole occupation may simply be reduced to an automatic mechanism, especially if it is connected

with the good old style of disciplinary measures: "No. 1, 3, 5, 7, 9, etc., stand back! No. 2, 4, 6, 8, 10, etc., step forward! Hands folded! Hands up! Hands down, down! March!!!" etc. A workshop of children silently and mechanically performing certain motions with their hands, produces too much the impression of one of the state institutions for the correction of the young, not exactly credited with having produced such geniuses of thought and action as the Nasmyths, the Whitworths, the Goodyears, the Edisons, and others.

3. Manual training continues the work of the Kindergarten, which, of course, presupposes the full knowledge and solution of that problem. The pupil, nevertheless, has by that time outgrown childhood, and unless one imagines a uniformity in the mentality of mankind from seven to seventy years of age, some different stage of intellectual development is reached, and though continuing the Kindergarten, another work, psychologically speaking, is expected, the explanation of which is still to come. Then follows a whole series of claims set forth under the large and benevolent mantle of Industry. We begin with the sewing class and the agricultural Kindergarten, with the fields in a box four feet by five feet, minute plows, harrows, spades, etc. Scroll-work, taken from Krüsi's series of drawing-lessons, something like three hundred sketches of pitchers, vases, chairs, brooms, crescents, etc., all cut out to impress the idea of form upon the patient mechanic. Then innumerable pieces of wood, worked with the jackknife only. Plaster relief-maps, giving half an inch height to the poor Cordilleras, the whole of South America represented in six by nine inches, etc. Things valuable indeed in their way, but not warranting, as general educational measures, any outlay of state money.

Further, again comes the instruction in the use of the seven tools—adze, plane, hammer, drill, chisel, saw, gauge, etc. This at last sounds more serious and comprehensive, but still remains unpromising, if it stops there, and, unluckily, one does not have a chance to hear what is to follow. Such exercises may be carried out very successfully, experimental as they are in colleges, alongside of a full allowance of theoretical mechanics; but they are by no means the Alpha and Omega of manual training in a common school. Finally, we have a series of trades with their gamuts of so-called elements, wood-work, modeling in clay, metal, and stone work, etc., representing a dozen or so of trades, the elements of which are expected to be mastered. No one can deny a practical side to this programme, only it is apt to embrace either too little or too much.

The enthusiastic statement of the advocates of this system, that the ground principles of any trade are practically learned in

any particular number of lessons, appears too sanguine altogether if compared with actual reality. It is true that a given number of lessons of practical instruction in the tool-house may give quite a broad understanding of the elements of the trade to students conversant with its theoretical knowledge; but such is not granted, and hardly possible, in the case spoken of. Theoretical mechanics calls for its quota of higher mathematics, which is here outside of the question. Practically, then, we run the risk of turning out Jacks of all trades and masters of none. The pupil graduating from any of these departments will in the best of cases be an indifferent artisan. He will certainly have acquired an acquaintance with tools, and will possess considerable insight into the special arts, but empirical, detached, and uncorrelated as his knowledge would be about the processes, the habitual routine, a good portion of life's experience, will be still wanted to make him a desirable article in the industrial market. Besides, although it unmistakably would increase the efficiency of our workingmen, public schools can not be converted into special trade schools. Thus it is clear that the field is open as yet for a theory and practice in industrial training, which, taking hold of the necessities felt, and basing a system of instruction upon a rational method of analysis of the age of the pupil and his other educational requirements, would suggest a method that would finally bring the discipline within the ranks of serious educational measures.

The understanding of the cause of a given movement is almost equivalent to the mastery of the movement. Considering the increased interest in industrial training, one can perceive in it the reaction of two great demands for change and relief—to wit, the economical industrial, and the educational proper. In industry, the world, propelled by the advance in knowledge of natural sciences, has outgrown the old apprentice system. Sciences applied have made the old trade secrets a tradition of the past. The multiplicity of machinery has made the special skill of handwork, previously so important, only a secondary consideration; it has also occasioned a subdivision of labor so definite and minute, as apparently to make even the special knowledge of a whole trade not indispensable, so long as a workingman may simply be continually employed to attend to some special machine. The result of such industrial development, considered from that point of view, has only diminished the need of personal initiative, and gradually changed the "previous master of tools into the tool of a machine." New patents, improvements in process or machinery, introduction of new devices, so frequent in industry to-day, have diminished also the permanency of employment. A special worker or feeder on x y patent machine becomes obsolete as soon as x' y' replace the previously used x y; and, one-sidedly

trained, as he generally is, hardly capable of immediate satisfactory work on the improved plan, our poor fellow is thrown out of employment; he generally undergoes untold misery and suffering before being employed at something else. Of course, strikes and other labor combinations may, to a certain extent, extort from capital some extra allowances. Organized labor may command a higher price, may even go so far as to form an insurance fund for the unemployed; but neither legislation nor organization will ever root out the evil, because they do not destroy its cause. After all, out of the total capital employed in the industry of a given country, there is only a certain percentage to be spent in wages. As soon as capital can not obtain its economical due, it flows into other channels, often outside of the country itself; and as there is no friction possible without material wasted, it is for a short time only, economically speaking, that there can be found an apparent redress for labor through the terrorism of labor. Ultimately it will turn out against it, as the stoppage in the industrial wheel occasions a loss to capital and labor that both are sure to feel, and which generally is felt more harshly by labor.

Co-operation is a magnificent theory; indeed, it reminds one of the golden age; but, practically speaking, it will, like any other scheme, be subject to considerations of profit and of remuneration, *pro rata* of the intellect, work, and capital (money) employed; and no ism, notwithstanding its popularity, or even its majorities, will destroy this horrible *pro rata* distribution. Besides, any co-operative scheme needs genuine abilities, not found in a fossilized mentality of a one-sided training and more than one-sided occupation. The change demanded, therefore, has to be of another nature than can be brought about by organization, legislation, isms, etc., which by their very presence eventually demonstrate the necessity of a change. It has to go deeper; its workings will be a matter of the future rather, and the result of a systematic and well-calculated movement in the right direction. It simply aims at a regeneration of our workingmen of the future.

An educational regeneration, an increase of their capacities, their initiative, their artistic taste, and their power of invention—such elements, once present, would augment the value of our industrial products. They would allow us successfully to compete in the foreign markets, not by lowering prices, but by the superiority of our articles in quality, durability, finish, and elegance of design, and would thus increase and not diminish the share of wages. France, England, Germany, even Russia, have actually accomplished this by introducing schools of design, modeling, etc., alongside of their various special industrial centers; but France and England had their traditional specialties centuries old. In this country, with so many more industrial facilities, with so

many more possibilities for diversified specialties, we want more than schools of ornament, good as such may be. Unable to compete with the low prices of European or Indian manual labor, we leave it to our machinery, and expect our workingman to enable us to enhance the value of our articles by the helping presence of industrial brains and knowledge, so important and generally better paid than manual labor alone, and for that result we look to industrial training as a means.

So much for the economical consideration, now as to pedagogics proper:

Education, the fitting for life. Life, unless your father is a millionaire, and does not spend or lose his millions before he dies, sums up practically in an activity in some profession, an activity aiming at a decent self-sustenance; professions outside of poetry and art, the inspirations and special proclivities of which we will not discuss. Professions may be summed up as clerical, legal, and literary or scientific. We have unmistakably succeeded in perfecting the training preparatory for some of them, and, as it stands to-day, defy any European institution to supply accomplished clergymen or lawyers in a shorter time and at less expense. Literary men escape our arguments for the same reason as artists and poets.

Clergymen we want, in order to maintain the phase of culture and the methods of thought which it is their function to care for. Lawyers can do no harm, even if there should be too many of them, as law well understood by the greatest number in the community is a safeguard against the thrilling and dramatic in public life, an element not exactly in demand; besides that, a lawyer can always do good service in legislation; but how is it about our mainspring as a nation, our technical and scientific men? Gain, pleasure, or respectability, directly connected with a special branch or pursuit, makes one or another profession more or less desirable. Inductive knowledge has recently made gigantic strides. Scientific knowledge has acted as the great lever of respectabilities. The traditional liberal education is but a phantom of the past, and the parlor accomplishments of the old, refined type, lightly glancing over the poetical, the artistic, the ideal of human nature, etc., is slowly but surely making way for the less voluble but more serious and practical gifts of the thinking individual of modern times. Scientific culture is already recognized as an equivalent of the literary, if not its superior. Slowly but surely, the sciences have gained their due places, and an ignoramus alone would refuse to credit them with the motive power of our advance in civilization. Scientific professions, therefore, would be found desirable and respectable to-day as a specialty in the liberal arts so called. This granted, let us approach the subject

more nearly. Based on actual experience, the methods now prevalent in sciences are inductive, and call for experimental work as indispensable. Scientific knowledge of to-day may be said to begin its inquiries with an experiment, and to prove the correctness of its conclusions by another. A facility of manipulation, therefore, the aptitude for laboratory work is all-important, and this may be found by analysis not to be the result, as it is often popularly accepted, of natural or inborn talent, etc., but to represent a special training, a special knowledge, thus:

1. We expect a well-developed perceptive power in the senses, delicacy of touch, a minutely trained eye, ear—yes, even nose.

2. A steadiness of purpose, and a patience understood only by those who have worked on the same problem repeatedly and unsuccessfully, often for weeks, before they could obtain the desired results.

3. A synthetic initiative in putting things together, a laboratory intuition, so to speak, which, like any other intuition, merely represents an unconscious storage of the data of numerous antecedent trials and attempts.

4. A knowledge of the nature of materials employed, say those that we may justly call materials of construction.

5. Knowledge of the elementary laws in sciences, some mechanics, some chemistry, to be afterward supplemented by the adequate systematic study of mathematics and the philosophical analysis of theories.

Such, in short, are the prerequisites for a modern scientific apprenticeship, and such a preparatory training, both in knowledge and manipulation or practical work, is expected to result from the innovation recommended—the industrial training or the experimental laboratory connected with every technical fitting-school.

Within the writer's memory, instruction in sciences has been entirely revolutionized in its methods. It was suffering from the traditional scholasticism and its influence, modernized into that terrible bugbear the classical languages. Definitions learned by rote used to mark the first hard steps of the embryo engineer, geologist, or chemist, etc. Definitions numbered by the hundred then, of which very few have withstood the test of time, most of them having vanished with Torricelli's vacuum theory, etc.

A boy might then have had all the qualifications that we would look for to-day for a future scientist. He might have had a deep interest in any mechanical contrivance—for instance, taken watches apart and put them together, picked out all the needles out of his mother's drawer with a magnet, have been enthusiastic about a horse-power, say a thrashing-machine, or have successfully, although with some slight mishap, tried the properties of gunpowder, of sulphur, of phosphorus. The little fellow may have

been seen standing for hours before that mysterious automaton, a steam-engine, his little body unconsciously following the motion of the fly-wheel, his eyes fixed intensely upon the valves or gears. On inquiry he may have given you satisfactory explanations about the working of the engine, describing minutely its parts and the way they are put together, information that he had acquired incidentally and all by himself; and yet the same boy, after a year or so in the school, would have often been pronounced a dunce by his learned teacher, and specially without any love for natural sciences. Why? Simply on account of his inability to recite correctly the generally incorrect definitions. Many a bright school companion of the writer, having in him all the material wanted to make a splendid technical student or scientist, became a classical literary nobody on account of *the definitions*. Then, again, what a horrible crime, was it not, to have dirty and lacerated fingers, resulting from some little galvanoplastics or the like! "So ungentlemanly" was another time-honored intellectual obstruction. It may have saved a few dollars' worth of clothes, and even taught some so-called respectability to the boy, but it killed many a good brain.

Gradually, nevertheless, things began to change; actual experiments began to accompany the horrid book of definitions. It is true the teacher, himself generally a very inefficient practical worker, kept all the apparatus locked up, and only on extra occasions was the glass closet opened; but then, what a joy! what an interest! what a number of never-ending questions! When of a sudden down came the marks for noise, disrespect toward the teacher, speaking without permission, and so on. The presence, however, of the apparatus, even behind the glass doors of the closet, strongly contributed to the general interest in the matter. How eagerly did we not study our abhorred definitions and work for good marks, so as to have the privilege of taking out the apparatus from the closet!

In college the collection was more complete, and you had even the right to touch the apparatus, although the teacher alone performed the experiments. Soon, however, came the greatest and the most charming of innovations, laboratory experimental work, and finally regular laboratory instruction, when of a sudden—eyes did not see, nose refused to smell, in chemistry; fingers were found clumsy and the dimensions badly guessed at in physics. Broken glass without end, cut fingers innumerable, miserable experience with the apparatus, that generally refused to work, discouraged many a scholar, especially if the not always good-humored professor or his assistant repeatedly pronounced the melancholy decree: "You will never accomplish anything, Mr. So-and-so. You can not see, you do not smell, you do not recog-

nize the difference between this precipitate and that other. Do you think that you ever will be a chemist, sir? An illusion, sir, an illusion, a sad one; waste of time and your father's money; better take a course in theology or judicial jurisprudence." Well, many such an illustration may be real to-day also. It is true we have gone a step further since; we have now in most of the colleges that respect themselves physical laboratories, generally well mounted; here instruction is received and practice is obtained in scales, dimensions, standard units, etc. But what would have been a heaven for the twelve or thirteen years old boy becomes only too often the place of torture for the nineteen, twenty, or twenty-one years old young man; unsuccessful in his attempts, clumsy because not trained beforehand, he often wishes the whole recitation to forgetfulness; and a large number of students remain afterward mere designers in technical offices or poor lecturers on the so-called popular sciences, instead of following a successful scientific career, doing original work, and possibly realizing discoveries, improvements, wealth, and honor. The many failures here ought to serve as an emphatically practical lesson on the necessity of adapting work to age.

When the young man enters the laboratory at college, he ought not to encounter any mechanical difficulties. His attention ought to be chiefly directed to more abstract thoughts, to his theories, his laws, etc. Expert with his fingers, his senses trained, he ought to be able to note differences and similarities in the experimental phenomena, formulate his hypotheses about them, and verify them. Very recently the writer had a good chance of seeing the above practically illustrated. The son of one of our leading citizens, entering his second year in Princeton, who had just the training (tool-house work) recommended, was present at the recitation in physics; a fine apparatus was brought in and the professor had some trouble in explaining to the class the working of the micrometer-screws in the apparatus—in other words, the way the principle of the micrometer-screws is practically applied. The writer's acquaintance, handling the screw in his turn, suggested to the professor the possibility of doubling the delicacy of the scale by letting in another screw within the first, a suggestion that was willingly accepted, and as far as he knows executed. The older young man wants as the basis of enthusiastic exertion, a higher generally practical purpose than merely the routine of manipulation, or the preceding wood and metal work found in some colleges; besides, he hardly has any time for it; of course, he submits, but generally, in direct ratio to his intellectual development, he gets disgusted with the practical drudgery. At that age there is a restlessness of mind, a flight of imagination, an elasticity of thought, that can and ought to be utilized more ad-

vantageously than the training of the hand and eye principle. This, as we saw, belongs duly to the fitting-school and not the college.

Thus sciences are found to-day to call for an adequate elementary preparation, and this one requires, as we have seen, an adequate training of the senses to be begun at the natural age alongside of certain elements of knowledge. It is ridiculous to expect that such a minutely specialized field as that covered by the sciences to-day should suddenly be successfully approached by some mysterious roundabout way, and through the study, say, of Roman antiquities and the like, which have no bearing whatsoever either on the theory or practice of sciences or on the inductive reasoning found so important in these branches. Detached facts, with which you have to begin, may be easily seized and remembered by a boy of twelve, but they escape the mnemonic power of a young man from college; and if collegiate higher instruction is to bring fruits and actual results, its higher working must be free from elementary difficulties. We do not expect a young man who had not mastered arithmetic to begin calculus; and there is just as much discrepancy between atomic theory, specific heats, etc., and the experiments of the burning of a candle, hydrogen and oxygen generation, the piece of chalk and vinegar, etc.

So far, then, the future of industrial interests at large demands a general practical preparation replacing the old apprentice system. It is claimed for such a system that it would enable the workingman, through the command of adequate knowledge, to become free from his present bondage, and make him again the master, instead of the tool—not of capital, as some socialist friends would declare, but of his true superior and master, the powerful automaton, the machine. On the other hand, we find also a similar necessity claimed by the scientific professions. Equally with other concerns, one can but recognize that agricultural interests could be fully benefited only by the measure recommended, and that the business part of the population would hardly lose their time spent in training, as specialization in industry calls for an adequate specialization in business. Some general kind of technical or industrial knowledge would be easily appreciated by any business man, either behind his desk, in selling and buying, or in his leisure hours at home, where it would be found a valuable source of healthy exercise and recreation. The omnivalence, therefore, of manual or industrial training once granted, its methods may be now approached.

From the start it is evident that, instead of forming the additional fifth wheel of our pedagogical vehicle, the measure spoken of is entitled probably to a good half of the total traction.

Equally self-evident it will appear that, instead of representing only an additional exercise, separated from the rest of the instruction, perfect correlation with the same has to be established, if anything like serious results or benefits are to be expected. In other words, manual or industrial training can be summed up as the experimental adjunct of the abstract studies, verifying the correctness of the conclusions arrived at, in the shape of laws, theories, or principles, and demonstrating their practical adaptability. A pupil having some idea about the actual use of the things he learns is, without comparison, the superior of one who only hopes to find it out some time at college—if ever. As, nevertheless, the curriculum of a general popular, say, public-school or artisan education, varies to some extent, at least, from a preparation for a future profession, the special course in the experimental departments of the two will have to differ respectively.

Objective teaching, or the practical acquaintance with one's surroundings and Nature's chief subdivisions, will remain common to both—the value of such instruction being enhanced through the so called Socratic method of cross-questioning, but at a point of abstract concentration certain parts of the said objective instruction, say, in form and number, may in their further development form a line of demarkation. Form might lead to practical working draughts in the manual training of the first case, and number, entering here as the necessary accessory, would serve only for short immediate calculations. A more mathematical handling of the subject, subjecting facts to more minute calculations, and early introduction of the mechanical equations of cause and effect, will form the central pivot in the second higher grade of schools. Certain generally lightly treated truisms may be added in shape of suggestions to enable any worthy pedagogue to start logically in the progressive line of our educational innovation.

1. Mathematics has its origin in the concrete and not in the abstract, and therefore is more easily approached and more successfully taught on this basis. One has to start with actual things —dimensions, forms—especially when dealing with pupils of the elementary grades.

2. Space, notwithstanding Hamilton's arguments, viz., Stewart's, is conceivable to us only conjointly with the actual experience of muscular exertion; its notion originates with the turning of the eye of the new-born child and our pedimetric or other dynamic measurements.

3. Language is by no means our only agency for making ourselves understood; a few lines, if properly drawn, will tell a better story about many things in technics than a long-worded lawyer's version. The short-hand expression, sketching, is therefore an in-

dispensable grammar of its kind, found easier, more attractive, and especially more practical, than the beautiful series of definitions in honored Brown's or other memories.

4. In handling objective grades in elementary lessons on Nature, the teacher can with the same facility and with probably more profit select his illustrations in plants, stones, metals, from popular and locally well-known kinds than by rambling over the tropics, etc., for the ideal botanical or other type.

He thus introduces the essential materials of construction, and early establishes in the mind of his pupil standards of comparison, so much the more important as, taking the ease of their minute study into consideration, they can really be well and correctly understood. In physics or elementary mechanics an actual simple screw, a wheel, an axle, a real wedge, balance, etc., may be employed at that age with more benefit than the expensive micrometer apparatus. In this way a public-school pupil would finally be found in possession of considerable practical information and available knowledge. He would recognize the trees in the forest, the stones in the fields, and feel an interest in our every-day appliances, that would otherwise leave him entirely unaffected. In this way also, and connected with his arithmetic, elementary mechanics under their popular names may be successfully introduced, the pupil as well as the teacher being able to use immediately a stick for a lever, any plank for an inclined plane, any rubber or leaden pipe for a siphon, instead, as used to be the common practice in our various seats of learning, public and other, starting with the definitions of the undefinable force and matter, puzzling over Newton's laws, and finally trying, generally in vain, to remember the formulas of the p, the w, the f, etc., generally not mentally present, on account of the slight acquaintance with them. Add to this the letters, syllables, words, and sentences of our cosmopolitan short-hand, drawing, taught simultaneously with the correctly spelled vernacular, and we are ready for the exercises with tools, as every one of them is but an illustration of the principles of the now known lever, inclined plane, wedge, etc. The seven types then can be appreciated; they cease to represent simply pieces of steel. The pupil recognizes in them the material for many interesting problems requiring solution. He alternatively combines them or tries their identification in their various combinations, as presented to him by manifold machinery. He repeats the previously mentioned automatic movements; it is true, he passes through the graded series of exercises we have enumerated, but with what a difference in spirit and results! His mind, inert previously, is now full of activity, and the new kind of inertia, to which it is subject, that of motion, carries him steadily onward to future improvements and discoveries.

Passing through the systematic routine of instruction in wood-working tools, then the metal-working tools, the instruction in the materials of construction and recording his work systematically in his short-hand the drawing, the boy thus correlates things apparently detached; trains his judgment, and is fully able to supplement through self-study whatsoever special knowledge he would find desirable in a given time. Such a boy is sure not to depend for his living upon a special kind of machine. Why? Because he has learned how to understand and read machinery. The next point sure to come up, whatsoever we treat in our modern times, would be that of cost. Considering the return of very desirable and highly probable results, the outlay will be very small indeed. Some system, some logical analysis of purpose, some honesty of purpose especially, and we have it. Time and money being the chief considerations in the matter of public schools, a few suggestions may be allowable.

We are far from condemning the instruction, and far from making a crusade against the selection of branches even. Having visited educational institutions in many countries, the writer considers the American system superior to the others, and as most assuredly answering well the purpose intended. The only question is, whether that purpose is desirable. If collegiate education of a non-scientific professional character be the golden door of life's success, then the public-school system is the one wanted; but if, on the contrary, industry and commerce be accepted as the more important fields, then the system is a failure, not on account of its practice or standard, but simply as not supplying the demand. One of the most enigmatic objections against the innovation intended (emphatically), "The state has no right to prescribe the future occupation of the growing generation," sounds very decisive indeed, but has but little, if any, real bearing on the question. To answer one generalization by another, the writer may with the same weight put the following query: "Has the state the right to educate for no special occupation, although such is unavoidable in actual life? Or otherwise, has the state the right to teach the boy first that he is created with equal rights to enjoy life, to teach him what to desire, how to enjoy it, but not how to get it; and then legally crush him for having got, or at least attempted to get, the thing accepted as desirable, the best way he could? Many an educational veteran may puzzle over it.

Then, again, the argument that the instruction received has helped rather than obstructed many a case of the desired success in technical or commercial career, it may be answered that the proposed change will by no means prevent any individual from becoming a minister, a poet, a teacher, a politician, etc. On the contrary, it appears very plausible to admit that a manually

trained pupil would be more helped toward that end by his schooling than a scientist has been helped hitherto by the old routine. But if this be admitted, a considerable change of the present curriculum must follow. Thus, foreign languages in our public schools are, in the best of cases, a mythical adornment, nothing else. In exchange for the money spent for it, the amount of actual philological information is very small. The only available part of such instruction would be conversational ability, which of course can not be wisely expected as the result of the few half-hours in the week, because the detached grammatical particles of a lacerated foreign idiom most assuredly can not produce the least earthly good, and do often interfere as a bad mixture with the purity of our English. Equally so with geography and history. Taught as they are, they could with equal benefit be left out of the curriculum.

Geography is either the most valuable branch to the teacher or the most valueless for teacher and pupil both. If used as the great co-ordination means for a thorough instruction in elements of natural history, botany, geology, etc; if taken conjointly with the instruction in elementary knowledge about terrestrial atmospheric forces and their activities; if united to general information on the elements of history, beginning with some conception about man, his occupations, nature, etc.—then geography in the hands of a skillful teacher is *the branch*, is, so to say, the mnemonic key of general information, as without localization any information is of questionable value. But if representing simply detached memory exercises of so and so many hundreds of foreign names, etc., sure to be forgotten before the pupil is through with the book, then, of course, it is waste of time.

History also falls within the same criticism. "We are a law-making people here in America," says one of our educational lecturers; "we have to learn how to make laws"! Very poor article indeed. Fewer laws, so much the better, as every law exemplifies a shortcoming; but would it not be preferable, if one wants absolutely to make laws, to begin to study, not how to make them, but what a law is? Thus with history. If once the pupil could command something like a fair, honest information and understanding of what society is, of what his own circle is, his borough, his county, his State, their institutions, etc., with some elements of civil government, then of course he could trace the various historical reasons for the present institutions, have a rational idea of his own country as a standard, and compare it with others, but then only would he be ready for history; otherwise the couple of dates and stereotyped versions about the courage of the good Putnam and the cowardice of the English, the ideality of the North and the blackness of the South, etc., will be

only an evil, and unnecessarily feed the youngster, and that at a very impressionable age, with unjust prejudices. The writer had some curious experiences in that direction, especially when, for the fun of the thing, he wanted to have Republicanism and Democracy defined and limited by Republican and Democratic voters, graduates from public schools, and, he is sorry to say, graduates from apparently known colleges also.

To sum up, more grammar and less grammatical instruction would also be desirable. Mathematics more practically taught, problems of actual use from elementary mechanics, would, for instance, be found more useful than the traditional apple cut up into $\frac{9999}{1111}$ parts, and would equally well illustrate the principles intended in arithmetic.

Then, with a few dollars spent for plant and materials in industrial education with drawing, we should have our public schools doing really a great work, because actually preparing men for real life.

Following the woman emancipation question we shall probably see a number of clerks gallantly leaving their places to so many lady candidates, book-keepers, etc., and possibly shall we chauvinize ourselves sufficiently to recognize and socially respect (not politically) our new gentleman in overalls, but at large society will have gained only by that; and probably our hot question now, that of labor and capital, will have lost considerably of its disagreeable aspect. General smartness, and what we call general literary information, have had their day; they do not protect us now from a very unhygienic and unsavory fare. Now, as to the special course of manual training in higher preparatory schools. A chemical laboratory, a physical laboratory, scales, standards of measure, specific gravities, thermal, barometrical, electrical units, more minute calculations, would represent the variety necessary, covering the scientific parts more minutely, but by no means dispensing with actual shop practice and thorough work in it. Such training will be found very useful in a professional career; it will enable also the future leader of work and labor to estimate it thoroughly, to understand its difficulties and its actual value, and therefore its needs and rights. It may do away with some of our typical social *dilettanti*, but most assuredly it will create the true social type of man, struggling for his existence, and surviving because the fittest, but expecting more profit from, and directing, therefore, more energy toward, the struggle with Nature and her forces than toward a battle with his fellow-men.

SKETCH OF PAUL BERT.

IN Paul Bert we have an example of a man who was able to achieve equal eminence in scientific research and in political life; and one of those extremely rare cases in which the excellence of scientific achievement was not apparently marred by the worker's participation in political activity. Announcing his death in the Chamber of Deputies, in November, 1886, M. de Freycinet said, "The members of the Chamber lose in him an eminent colleague, science one of its most illustrious representatives, and the Government an inestimable fellow-laborer in whom it had placed entire confidence."

M. BERT was born at Auxerre, on the 17th of October, 1833. He pursued his studies in his native town and in Paris, and obtained the degree of Doctor of Medicine in 1863. His graduating thesis was upon animal grafting, and in it, M. Gaston Tissandier says, the physiologist marked himself as an eminently original investigator and skillful experimenter. Three years afterward, in 1866, he was admitted as a Doctor in Natural Science on the basis of a thesis upon the "Vitality of the Animal Tissues." His first labors attracted attention particularly by the interesting and curious nature of the results obtained. Animal grafting, an operation consisting of the removal of a living part and transplanting it so that it shall continue to live on another part of the same individual or on another individual, was studied in a special manner by the young physiologist, who was enabled thereby to shed a new light on the properties of the nerves. This was remarked by Claude Bernard, in whose laboratory he became an assistant, who discerned an ingenious mind in him, and predicted the brilliant future that awaited him. In 1865 the Academy of Sciences decreed to M. Bert the prize in Experimental Physiology. Two years later, in 1867, he was appointed to a chair in the Faculty of Sciences at Bordeaux; and in December, 1869, he was named Professor of Physiology in the Faculty of Sciences in Paris, as Bernard's successor. Here, in the possession of a vast field of study, M. Bert, with the financial aid of Dr. Jourdanet, constructed costly and magnificent apparatus for the execution of experiments on barometric pressure in relation to the effects it exerts on the organism. Dr. Jourdanet, having removed from the borders of the Gulf of Mexico to the highlands of Anahuac, had observed differences in pathological conditions, which he discovered, to his surprise, were not simply such as result from temperature or are paralleled in places of lower level and higher latitude, but presented peculiarities which he conceived to be dependent on the elevation of the situation alone. Among these conditions was

a poverty of the blood-corpuscles in oxygen, which he believed to be a result of the feeble pressure of the atmosphere in those regions. In the study of the question of the influence of atmospheric pressure on health, which he was led by these observations to undertake, he availed himself of the aid of M. Bert's experimental skill. M. Bert performed a long series of experiments upon small animals exposed to atmospheres of various pressures. The book in which he gave an account of them includes full reviews of excursions into great altitudes, of observations on mountain-sickness, and of balloon ascensions to great heights. An experimental ascension in the balloon Zenith was made in 1875 in aid of this investigation, its special object being to determine the quantity of carbonic acid contained in the atmosphere at an altitude of twenty-four thousand feet. Three persons went up in the balloon, two of whom, M. Sivel and M. Crocé Spinelli, perished at a height of about twenty-four thousand feet, from the effects of the rarefied air, while the survivor, M. Gaston Tissandier, was made insensible for a considerable length of time. The main cause of the disaster was believed to be "the vertigo of high regions," by which the aëronauts were excited to throw out ballast and go higher, when prudence should have dictated to them to descend. The main object of the expedition was not attained, because the instruments also were thrown out and broken. The balloon reached a height of eight thousand six hundred metres, as was shown by the maximum barometers. The results of Prof. Bert's experiments were published in 1878, in his work "La Pression barométrique; Recherches de Physiologie expérimentale" ("Barometric Pressure; Researches in Experimental Physiology"). Among his principal conclusions were those that the diminution of barometric pressure acts on living beings only by diminishing the tension of the air which they breathe, in the blood which animates their tissues, and by thus exposing them to the dangers of asphyxia; that the increase of atmospheric pressure acts only by increasing the tension of the oxygen in the air and the blood; that the inconvenient effects of diminution of pressure may be efficaciously combated by the respiration of an air sufficiently rich in oxygen to maintain the tension of that gas at its normal value, and those of the increase of pressure may be combated by employing air sufficiently poor in oxygen to arrive at the same result; that the beings actually existing in a wild state on the surface of the globe are accommodated to the degrees of oxygenated tension under which they live; that barometric pressure and the proportion per cent of oxygen have not always been the same on our globe—the tension of the gas has apparently been, and will without doubt continue to go on, diminishing; and that it is inaccurate to teach that plants must have appeared on the earth be-

fore animals, in order to purify the atmosphere of the great quantity of carbonic acid which it contained. In fact, germination, even that of mildew, does not take place in air sufficiently charged with carbonic acid to be fatal to warm-blooded animals. It is quite as inaccurate to explain the anteriority of reptiles to warm-blooded animals by the impurity of the air tainted with too much carbonic acid. Reptiles, in fact, are more injured by this gas than birds, and still more so than mammals.

For these experiments, the Academy of Sciences, judging them worthy of the highest recompense in its power to bestow, awarded to Prof. Bert its grand biennial prize of twenty thousand francs.

Another important research of M. Bert was concerning the safe administration of chloroform and other anæsthetics, for which he devised a special apparatus.

A considerable portion of the work of Prof. Bert was performed in the public service. After the military disasters of 1870, he became Secretary-General of the prefecture of the Yonne, and in January, 1871, prefect of the Département du Nord. He resigned this office when Gambetta retired from the Department of War. He was chosen deputy from the Yonne in 1874; took his seat among the Extreme Left; and participated actively in the discussions of the National Assembly, particularly on questions relating to ecclesiastical and educational matters, strongly opposing the pretensions of the clergy to control the education of the young, making alarming exposures of the abuses which it was alleged they had allowed to be introduced into the schools, and condemning the teachings of some of their text-books. He advocated the giving of an annual pension of twelve thousand francs to Pasteur, and was one of the deputies who, in 1877, refused to give a vote of confidence to the De Broglie ministry. From 1877 to 1879 he represented the Canton of Ailtenet in the General Council of the Yonne. His appointment, in 1881, in the Gambetta ministry, as Minister of Public Instruction and Worship, was regarded with great disfavor by the clericals, who looked upon him as their pronounced enemy. His administration of the office was able, and furthered the movement to secularize the schools. The bill passed by the Chamber in March, 1884, was his work, and was a stringent measure for the accomplishment of that purpose. It directed the Government to secularize the state schools entirely within five years, by appointing lay teachers instead of the friars and nuns, who had a large proportion of the schools under their control; debarred the clergy and members of religious orders from the direction of primary schools as teachers, inspectors, or members of the educational councils, or of the officially appointed school boards; and forbade lay instructors from accepting salaried employments in the churches.

M. Bert was appointed in January, 1886, French Governor-General of Tonquin, and Minister-General to the court of Anam, where his functions were to be largely those of organization. He engaged himself with the duties of this mission with characteristic enthusiasm, applying himself almost equally to the performance of the civil work of his position, and to efforts for the encouragement of science in the new French dependency in which he was stationed. One of the last occasions on which he appeared in public in France was at the unveiling of the statue erected at the entrance of the Collége de France to the memory of Claude Bernard, where he delivered one of the addresses. At the ensuing meeting of the Academy of Sciences he made a farewell address, in anticipation of his departure, in which he expressed a hope that the young naturalists of the West would begin to turn their attention to the far East, and teach the learned classes of those regions more fully to appreciate the superiority of European science. "I rely on them," he added, "to increase our moral influence, and also to enlarge our knowledge of that region, in many places still unexplored, to study its resources, and prepare the way for the introduction of the great European industries. They will thus at once promote the interests of science and of France, a task enviable beyond all others."

Shortly after he had settled himself in his office in Tonquin, M. Bert published a decree to carry out a project, which he had entertained and matured before leaving France, for founding a Tonquinese Academy, on a plan similar to that on which Napoleon created the Egyptian Institute in 1798. It was set forth, in the preamble to this paper, that it was desirable to revive in the country which had been disturbed for so long a time the taste for literature and science, and to preserve to the people the vestiges of its glorious past, as well as to collect the scattered evidences of its ancient splendor. It was provided that the seat of the academy should be at Hanoi; and that its functions should be to investigate and collect everything of interest relating to Tonquin, to preserve ancient monuments, to initiate the people into the knowledge of modern sciences and civilization by translating and publishing in the Anamite language summaries of European works; to translate desirable Tonquinese works into French; to aid in forming a national library at Hanoi and public libraries in the principal towns; to publish monthly bulletins treating of scientific and other questions; and to put itself in relation with other Oriental societies in Europe and Asia. Various degrees would be given by the academy to Tonquinese, to be marked by a medal or emblem to be worn on the dress.

One of the last letters written by M. Bert from Hanoi was in reference to the improved lighting of the city at night. Gas being

too dear, and the use of petroleum being a "barbarous expedient," he was anxious to know whether it would not be possible for him to make the Red River, which flows past the capital, produce the required illumination. "Would the expense be great?" he asked. "Only think, if we succeeded, we should be ahead of England and Japan! . . . Answer, and answer quickly; my days are numbered." This letter was deposited, by vote, in the archives of the Academy of Sciences at Paris.

During the first months, of his stay in Tonquin, M. Bert enjoyed the best of health. But the constant friction which existed between himself and the military authorities worried him, and the climate of Hanoi wore upon him. He concealed, as much as possible, the fact that he was becoming ill, and was anxious that none but good reports should go out concerning the country. When called to go to Anam in September, it was remarked on board the steamer that "he was ever full of that good humor which he had the gift of communicating to others. He was always surrounded by a little circle of friends, who left him the stronger and the better advised. At table his marvelous appetite contrasted curiously with the dejected features and languishing airs of his traveling companions, and it seemed as yet impossible to believe in his unforeseen, sudden death." "It is difficult," says the author of a letter in the "République Française," describing a "Last Interview" with him at this time, "to form any idea of the indefatigable activity which M. Bert had displayed ever since his departure from France. At Hanoi he was shut up in his room early in the morning till his family came to call him to breakfast. In the middle of the hot day, at the hour which even the most robust dedicate to rest and quiet, he was found at his work, which only ended at five, with the end of the day. At five—his family were waiting patiently for him; they were all going to drive out together, but the time passes, and M. Bert does not appear. He is looked for everywhere, and at last he comes, only to tell his friends that an officer is dying at the hospital, or that one of his functionaries is ill, and that he must go and see them both. At the Hanoi hospital, whence the French soldiers and travelers are buried who have died in the neighborhood, M. Bert followed each coffin to its last resting-place. Times without number he has walked through this hospital, distributing books and medicines, and bringing such consolation which only those can fully appreciate who have been ill away from their own country and their own people."

Two weeks before his death he telegraphed confidentially to M. de Freycinet that he was ill, and it would be well to appoint his successor. M. de Freycinet replied that it would be better for him to rest, and that his retirement would be detrimental to the public interests; and he responded: "You are right; better die at

my post than quit Tonquin just now." He had gone for rest to the Doson Peninsula, a favorite resort of Europeans in Tonquin for recreation, where he had built him a small house in which "he intended to rest when he should be tired." He suffered a fresh attack of dysentery, from which he died in five days, on the 11th of November, 1886. On the announcement of his death in the Academy of Sciences, addresses were made by President Jurien de la Gravière and M. Vulpian, in which references were made on the great services which he had rendered to science—especially in his researches on the action of light on living organisms; on the physiology of respiration; on the influence exercised on man, animals, plants, and ferments, by increased or diminished pressure of atmospheric air, of carbonic acid, and of oxygen; and on his theory of the physiology of anæsthetics, and his efforts to render absolutely inoffensive the inhalation of protoxide of nitrogen. M. Bert, M. Vulpian added, was endowed with one of the most open minds to be found, and his prodigious facility in work permitted him to bring many tasks to the front. Most of his researches were undertaken and carried to a good result while he seemed to be wholly given up to labors of another kind. What might we not yet have expected from his indefatigable energy?

M. Bert was endowed with an extraordinary capacity for work. Although in his latter days political life seemed to absorb his attention, he found time to receive numerous visitors, to prepare standard works, to write scientific articles, and to keep up a voluminous correspondence. While he was regarded by the general public as harsh and authoritative, he was in private life a man of charming simplicity and a most agreeable conversationalist. His Wednesday evening receptions in his apartments in Paris were most agreeable occasions to all who were privileged to participate in them, and were marked by a free flow of conversation in which the host was among the most lively talkers, and science always held a prominent position. He had, says M. Gaston Tissandier, an absolute faith in himself, and did not believe that his star could be dimmed. He departed for Tonquin with the feeling that he had a great duty to perform, and was glad to believe that the difficulties in the way of his mission would yield before his determination to triumph over them.

Besides the volume on "Barometric Pressure," already referred to, M. Bert's chief publications were "Revue des Travaux d'Anatomie et de Physiologie publié en France pendant l'Année 1864" (Review of the Works on Anatomy and Physiology published in France during the Year 1864), 1866; "Notes d'Anatomie et Physiologie comparées" (Notes on Comparative Anatomy and Physiology), second series, 1867–'70; "Recherches sur la Mouvement de

la Sensitive" (Researches on the Movement of the Sensitive-Plant); "Leçons sur la Physiologie comparée de la Respiration" (Lessons on the Comparative Physiology of Respiration), 1869; "Recherches expérimentales sur l'Influence que les Modifications exercent sur les Phénomènes de la Vie" (Experimental Researches on the Influence which Modifications exercise on the Phenomena of Life), 1874; "La Science expérimentale" (Experimental Science), 1878; "La Morale des Jésuites" (The Morals of the Jesuits), 1880; "Leçons, Discours et Conferences" (Lessons, Talks, and Lectures), 1880; "Leçons de Zoölogie professées à la Sorbonne" (Lessons in Zoölogy taught at the Sorbonne), 1881; "La première Année d'Enseignement scientifique: Sciences naturelles et physiques" (The First Year of Scientific Knowledge: Natural and Physical Sciences), 1882; "L'Instruction civique à l'École" (Civic Instruction at School), 1882; and "Discours parliamentaires" (Parliamentary Addresses), 1882. For many years he furnished a scientific *feuilleton* to M. Gambetta's journal, "La République Française." The "First Year of Scientific Knowledge" has been translated into English, and is published by D. Appleton & Co. It is intended for children beginning to study science, and has probably no superior in suitableness for that purpose. It has proved an extraordinarily popular book in France, where it is said to have made the author's name known to a vast number of persons who knew nothing of his eminence either in science or in politics.

PROFESSOR ARCHIBALD GEIKIE names four obvious sources of information regarding former conditions of the land: the testimony of historical documents; the names of places; tradition; and geological evidence. The historical testimony is not always direct, but is often very strong by incidental reference; and of this character are the allusions in poems and romances. Numerous local names which have now lost significance or seem inappropriate, are found upon analysis to have been descriptive, at the time, of the places on which they were conferred. So tradition, when well sifted, often throws light upon mooted points. Geological evidence is the best, the most accurate, the most lasting, and goes farthest back.

SOME excellent maxims are given in a book on "The Ministry of Fine Art to the Happiness of Life," by Mr. Gambier Parry. On "The Purpose and Practice of Fine Art," the author says that "fine art comes of the union of love and labor, for without love it has no sufficient motive, and without labor it can have no success." The first step in a student's life, he adds, "is to divest his mind of all idea that genius can dispense with labor." A glaring fault of much of the work of the day is rebuked in the precept, "Of all the vices which pollute the source and thwart the progress of fine art, the striving after novelty is among the worst." Impatience and fickleness of purpose are condemned in "the genius most precious to mankind is continuous."

CORRESPONDENCE.

INDUSTRIAL ADJUSTMENTS.

Editor Popular Science Monthly:

I BELIEVE it will be the verdict of the readers of Hon. David A. Wells's papers recently concluded in the "Monthly" that they have given the most luminous sketch of the complex courses of modern industrial life that has yet appeared. Probably no writer has fortified his ideas by such a broad acquaintance with the living facts of industry; none has reached his conclusions by so wide an induction. And the absence of partisanship in ideas, the "philosophic calm" attained by so few even among philosophers, have been shown by Mr. Wells in a remarkable degree.

Instead of vague and incoherent talk about stock-watering, the Standard Oil Company, Jay Gould, speculation, and other all-sufficient "causes," we have had clear statements of the actual facts observed in the various departments of trade. Mr. Wells has shown us how one change in business led to others, and how these others disturbed still others; how nearly every walk of life has been greatly changed by the introduction of new processes, dependent, primarily, upon the application of steam and electricity to industry. From this review we see how little individuals have controlled the course of events, and how inevitable has been the revolution through which we have passed; and how Legislatures and States have been little more potent than individuals. In fine (if I may venture to state comprehensively the net result of Mr. Wells's papers), we have been shown that—

The industrial disturbances lately felt throughout civilization have consisted in the economic waste, the displacement of occupations, capital, skill, and social habit, due to the rapid and unceasing change in the methods of production and distribution; which change was itself due principally to the great mechanical inventions; that, among business classes, panics have been the result of the continual overthrow of established forms of business by new forms, and the unequal and disorderly rush of capital into these new forms, alternating oversupply with scarcity; and that among the laboring-classes there have been a corresponding displacement, insecurity, and suffering.

That part of Mr. Wells's essay which deals with the remarkable increase of social discontent attributed to our time seems to me the least satisfactory part of his performance. The result of his observations on this point seems to be that there is no valid reason for this discontent, and that the "laboring" and all other classes are better off than ever before. He indeed shows that much suffering has arisen from the "displacement of labor through more economical methods of production and distribution"; as where the hand-loom weavers were thrown out of employment by the introduction of the power-loom. But he also shows that these displacements have been only temporary, that the demand for labor soon becomes all the greater because of the new methods, which must lead us to infer the insufficiency of the cause assigned to account for the phenomenon, especially as sudden displacements have taken place only in a small proportion of industries. Two other causes are assigned: changes in the nature of employments, which tend to degrade the operatives of factories, and a general increase of intelligence. But no very serious effort seems to be made to support these hypothetical causes. Indeed, they may perhaps be said to exclude each other. Man is certainly a very unfortunate creature if he grows unhappy both when circumstances lower his "grade" and lessen his intelligence, and also when his intelligence is increased. For such a state of things there would seem to be small hope of remedy, since we can scarcely hope to maintain a dead level. The reader is left somewhat in the dark on the matter.

Content and discontent are doubtless largely dependent upon the quantity and quality of the food we have, the money we lay by, and the houses we live in; upon all of which Mr. Wells throws so much light. But it is superfluous to argue that happiness is dependent on conditions much more complex than these. The greater part—I think by far the greater part—of the unhappiness in the world comes from other things than insufficient food, clothing, and shelter. "All happiness in life," says Goethe, "is founded upon the regular return of external things." This remark of the great philosopher and poet, for which the equivalent could doubtless be found in Spencer's writings, seems to me to furnish the key to the problem. Our race has been accustomed for numberless generations to harder work and infinitely greater risk and privation than it endures at present; but it also had a character inured through hundreds of years to its occupations and had habits and desires approximately conforming to its necessities. But the violent transition through which we have lately passed has probably changed to a very large extent the occupations of ninety-five per cent of the population within a single generation. The old, happy-go-lucky, sit-around-and-whittle-a-stick generation has been ruthlessly exterminated. Even the good old philosophy

of Franklin's "Poor Richard" has had to go; and, in place of the steady, conservative habits which Franklin inculcated, we have a fierce philosophy which perhaps best expresses itself in the current determination not to "get left," and to get there "fairly and easily if possible, but at any rate to 'get there.'" The industrial world has been revolutionized in a half-century; and the non-adaptation of the population to its industrial environment has put a severe nervous strain upon the entire race. Hence comes the great and annually increasing percentage of insane to be found in all civilized countries, and particularly in the United States and England. Our condition has been materially bettered, but this does not altogether compensate for the strangeness of the surroundings; and, like the child of the forest brought unwillingly into civilization, mental health longs for a little barbarism. Naturally, under the circumstances, the most striking of the ill effects of the strain imposed by the new conditions are found in the foreign population which comes to this country with so little preparation. The proportion of insane among this class is very great. But the force of the resisting and reactive tendency may be seen almost everywhere. A college president recently called in a state church as a remedy for our woes, a medicine in order some ten centuries ago. Among economists we have a "new" school, composed largely of young men of little practical experience, who have got their ideas in German universities, and who exhibit a profound partiality for despotic government, and the revival of that *régime* where "the state" was everywhere. In letters we have Carlyle, whose passion for the imperialistic, the feudal, the patriarchal, joins with his contempt for liberalism of every form; Ruskin, whose detestation of the steam-engine and modern arrangements in general reaches an insane pitch; and Tennyson, the central note of whose thoughtful poetry is one of unrest and impatience. These great writers faithfully reflect the feeling of many, and perhaps most of us; and similar tones are found in our lesser writers. It is rather ludicrous to note how often the newspapers call for "rigid" legislation of some kind or other. And of course the Legislatures and courts have not failed to reflect faithfully, as is their duty, the temper of society at large. Thus, along with our great advance, we are suffering the agitation and disquiet of a necessary reaction. Travelers on the St. Lawrence will remember a scene typifying our social situation. As the steamer falls into the swift current of the Lachine Rapids, and takes on a fearful speed, we notice short, steep waves angrily assailing us from front and sides. These waves are raised by the rapidity of the water's descent, which, rushing downward at a rate of twenty-five miles an hour, is lashed to fury by the air, just as a rushing air raises the still waters of a lake or ocean. And the very swiftness of the descent is indicated by, and makes inevitable, the violence of the resisting waves, as we shoot down to the calm waters below the rapids.

A republication of Mr. Wells's articles is very desirable. It seems to me that they will be accepted as the best contribution of recent years to economic science. Pardon my long letter. CHARLES S. ASHLEY.

TOLEDO, *May* 5, 1888.

FOG-SIGNALS.

Editor Popular Science Monthly:

SIR: Mr. A. B. Johnson, in his article in the May number, on "Sound-Signals," referring to my code, commends it as the best he has yet met with, but alludes to it especially as an adaptation of the Morse code. To correct any impression that might arise that my code was *suggested* by Morse's telegraphic alphabet, I beg to state that it simply has nothing to do with the Morse code, except that the different signals, long and short, with varying intervals of silence—or non-signaling—may be indicated by dot and dash on a compass-card or chart for convenience. The signals consist of whistle-blasts, indicating, not only the position of a vessel in fog or darkness, but also the direction in which she is moving. It is not designed as an alphabet, except to indicate *courses* being steered by vessels in danger of colliding if they did not indicate in some way as approximately as possible *their position and course.*

Without disputing the facts already stated in this magazine, and in previous articles by the same writer, founded on scientific observation — viz., that aberration of sound does occur from various causes, and that exact location of an object by sound may be impossible—still, it has been the ambition of the writer of this to establish the use of a code of fog-signals at sea designed to prevent collisions by indicating the course a vessel may be steering. At present, signals by sound between vessels in motion, indicating course, are given when they are each *in sight*, or at least when one discovers the proximity of the other. By the present code of signals they may indicate whether they will pass to the right or left of each other, and this is done by blowing one or two whistles to which the response is supposed to be favorable from the vessel signaled.

This code of signals may be good enough for every purpose when vessels are *in sight*, but gives at best *very slight warning* when vessels are approaching each other in fog or "thick weather." Something more is demanded as a warning of approach, and the more intelligible and informing this warning signal can be the better. It has been advocated that a signal indicating a vessel's course as being in either of the four quadrants of the compass—as between N. and E., E. and

S., S. and W., W. and N.—or between N. W. and N. E., N. E. and S. E., S. E. and S. W., S. W. and N. W.—be indicated by 1, 2, 3, or 4 whistles, corresponding to the number of the quadrant. In every case the whistles to be short, but preceded by one long one.

A suggestion has also been made that a "tattoo" or multiple whistle be given to indicate "I have stopped—you may go ahead." Some such system as this might be comparatively useful; the only question to settle in this regard is, What is *the best* system devisable? In endeavoring to answer this question I have made use of the long and short signal, which can be, incidentally, represented on a compass-card or otherwise by the dash and dot. These signals, given at intervals suitable to prevent confusion, will indicate *any* course on the compass, and can be read by sound as soon as they are in process of transmission. Opposite courses are indicated by opposite signals. N. and E. courses by one — and two — — long signals; S. and W., by one . and two . . short signals. Thus, as soon as the signal starts off, the navigator learns at once *something* of the *direction*, in a general way, soon to be particularized, in which a signaling vessel is moving, being thus enabled to avoid getting in the line of that motion, and so preventing collision. Actual experience tells us that navigators *do locate* approximately the position of ships by sound—of course with more accuracy by sight. When sight is unavailable, we *must* depend on sound. Yours truly,

FRANK M. PURINTON.

PROVIDENCE, R. I., *May* 1, 1888.

EQUALITY OR PROTECTION.

Editor Popular Science Monthly:

DURING the recent Parliament at Washington, one point seems to have been clearly developed—viz., that women are no nearer the ballot-box than they were fifty years ago—and this despite the efforts of an earnest and loyal minority. The truth is, that the masses of American women do not care to vote, and this wide-spread, persistent indifference leads us to hope that, at no very distant date, the restless ghost of woman-suffrage will at last be laid, to rise no more.

The word "equality" promises to be the next stumbling-block in the way of woman's real progress, and we can not but believe that the ladies who are acting in behalf of their sex are decidedly hasty and incautious in demanding, without limitations, "equal pay for equal work." At first sight, indeed, the proposal seems a fair one; and in art, literature, and latterly to a great extent in science, the equality of the sexes is unquestioned. But in the rough, every-day work of the world, where weakness means failure, strength success, where sentiment counts for nothing, and money-making is the paramount object, the matter is a very different one. That a woman can acquire the routine of almost any mercantile pursuit, may be admitted beyond a doubt; in fact, the quickness of her mind, and her rapid if superficial grasp of a subject, will give her the advantage, in many branches, over her brother-workers. Despite the utmost reserve and discretion, however, a woman is an anomaly in a business office, among business men, in the unrelenting tide of business life. She may do her work as well as a man would, be as reliable, as faithful; but her presence is an inconvenience, a possible restraint, only to be counterbalanced by the cheapness of her labor. No man, who is worthy of the name, can quite bring himself to treat a woman clerk as he would a man, even in this ungallant age; but in this business warfare the small courtesies of life are necessarily neglected, and an employer who has expressed his disapprobation or impatience without much regard to his p's and q's, may be dismayed on finding that he has insulted a female; for the slow masculine mind does not yet understand that women mean to prefer equality to respect and consideration.

Then, what might be called the transitory nature of woman's work must be taken into consideration. It can not be taken for granted that every woman who has to make her living will be old, ugly, and uninteresting; therefore, marriage must be considered as a possible if not a probable interruption to her business career. Unless domestic life is to cease altogether, she retires from outdoor vocations to fulfill her household duties. A man, on the contrary, will feel it the more necessary to keep his position, and advance himself in his business. In the face of such contingencies, can an employer be expected to pay equal wages?

In conclusion, is it not too soon for women to *demand* anything of the other sex? Equality means competition; competition means a fierce and ungenerous battle, from which many a strong man emerges sorely wounded and unvictorious. Are women fitted to enter into such a contest as yet? Will it not be a long while before their nerves will be strong enough, their muscles hard enough, their feelings insensitive enough, to make the fight a fair one? Is not Nature, potent and inexorable, behind the artificialities of civilization, the *real* bar to feminine equality after all?

In the mean time, it would be more prudent in women, even those termed strong-minded, not to scorn the protection of those of the other sex who are willing to protect them merely *because* they are women. And in their efforts for self-advancement and independence, let them rather *ask* aid, sympathy, and encouragement from their masculine fellow-workers, than demand an equality which the world is not willing to grant them, nor are they yet ready to receive.

MRS. L. D. MORGAN.

315 WEST MONUMENT STREET,
BALTIMORE, MD., *May*, 1888.

EDITOR'S TABLE.

THE STATE AND SOCIAL ORGANIZATION.

IT would probably be hard to find an expression around which so many false and confused ideas have gathered as we find clustering around the term "the state." In the course of an otherwise excellent article which we read lately in one of our educational contemporaries, we find "the state" described as being "simply society organized." Now, we can only understand by this that, apart from political government, there is no social organization; yet surely nothing could be wider of the truth. The fact is, that true social organization is seen at its best precisely where the state is not—that is to say, in those regions of social activity with which political government does not interfere. Think of our churches, our charities, our clubs and institutes of one kind and another, our commercial system with its constant tendency to higher and more complete organization, the newspaper press, the railway and telegraph systems, our multitudinous social arrangements, and the thousand and one purely voluntary agencies by which human intercourse is facilitated and improved; and at once it becomes obvious how misleading it is to speak of "the state" as being "society organized." It would be nearer the mark, in our opinion, to say that true social organization begins just where state action ends. The essential function of the central power is to preserve the integrity of the community by shielding it from external attack and internal disruption, and so to provide the conditions for social organization. In other words, the state maintains order as the condition of progress; but progress, if it is to be worth anything, must result from the innate powers and affinities of the units composing the social mass.

It should never be forgotten that the state, as such, proceeds by coercion. It does not ask for taxes; it demands and takes them. It does not use moral suasion on recalcitrants, but applies at once the *ultima ratio* of baton and handcuffs. If the state, for example, makes itself the champion of temperance reform, its language is: Do this, refrain from that, or—go to jail. But social organization, in the true sense, is not a matter of compulsion, and can not proceed from compulsion; it is a matter of growth; it means the sorting out and aggregation of like social elements, and the weaving by the whole body of society of such forms, usages, customs, principles, and institutions as are most in harmony with its character and conditions. What is effected by legislation simply can be overturned by legislation just as easily; but what is accomplished by a spontaneous growth of sentiment is really wrought into the very structure and fiber of society. There exists the gravest doubt to-day whether the state of Maine has gained anything whatever by its legislative prohibition of the liquor-traffic; many, indeed, hold that the cause of temperance itself has suffered through the measures adopted to promote it, and that the whole moral tone of the community has been lowered by the unceasing spectacle of the conflict between the prescriptions of State authority and the claims of individual liberty. Our form of government tends greatly to disguise the truth that social organization is a product of freedom. If a monarch or other autocrat were to enact certain laws that find favor in different parts of this country, there would be an outcry against his tyranny, and he would certainly be suspected of many a sinister motive. But, because these laws express the will of the majority, they pass

without challenge; the prior question is not raised whether the case is one in which the majority should seek to impose by force its will on the minority. The question is not asked whether society, if left free to act according to its own laws, would not in due time—which is always better than *undue* time—accomplish the good that is aimed at, and with better ultimate results than when force is invoked to hasten the reform.

The specific danger of our time is the easy access which mere majorities have to the law-making power, with the consequent passion our several communities have acquired for what may be called the law-making habit—a habit entirely comparable with the drink-habit or the opium-habit. We stimulate or soothe ourselves with laws, as the case may be, instead of striving to bring about the end we desire by free co-operation. We legislate (in the most futile manner) against oleomargarine, we legislate against "bucket-shops," we legislate against railway discriminations, we legislate, or threaten legislation, against "combines" and "trusts"; and, having legislated, we legislate again and again to make up the deficiencies or remove the contradictions of former legislation. Meantime the growth of free opinion and sentiment on the subject-matter of all this law-mongering is not aided but retarded. One result of this vicious habit is, that we do not give ourselves time to properly understand the workings of this or that tendency before we rush to legislation in order to forward or hinder it, according to the opinion we have been led to think it hurtful or beneficial. And how easily in many of these matters public opinion is swayed by mere catch-words no judicious student of public affairs can help being aware. As regards the treatment of our bodily ills, we have—at least intelligent people have—got to the point of distrusting the quacks who undertake to drive away every specific ailment by an equally specific nostrum; and we give our confidence rather to those who study the general conditions on which health depends, and who place their own chief reliance on the curative force of Nature. In statecraft, however, we hear nothing, broadly speaking, of general principles, nothing of the tendency of things to right themselves if left alone, nothing of the organic and organizing forces of society, but everything of the dependence of social well-being upon specific measures of legislation. Politically, we are yet in the dark ages. It is true we have thrown off the power of the personal tyrant, but we have not entered into the freedom of those who look to Nature for their guidance, and who resent the yoke of all arbitrary laws, no matter by whom enacted. The time will come when the art of government, like the art of healing with which it has many points of analogy, will be put upon a natural basis, and then it will be seen more clearly than now how little government has to do with social organization beyond providing for it the necessary conditions of order and stability.

A PHILISTINE CHAMPION.

A CERTAIN record tells us that when the Philistine army was drawn up in front of that of Israel, a champion of great size, arrayed in portentous armor and carrying a sword and spear of enormous proportions, came forth from the Philistine ranks and challenged the Hebrews to send a man to fight with him. We read also that when David, the son of Jesse, stepped forth to the encounter, armed with a few pebbles, the huge Philistine "cursed him by his gods." Now, somehow or other, the Lord of Argyll and the Isles, who has lately stood forth, from another "Philistine" camp, to challenge the hosts of science, and, if not to curse, to indulge at least in some good Homeric *loidoria*, reminds us powerfully of that Goliath of Gath who had so vast a contempt

for David and his pebbles, but whose strutting and boasting one of those pebbles brought to a sudden end. The duke is not a man of huge physical stature—quite the reverse people say who have seen him; but he is armed in a panoply of multifarious knowledge, he is practiced in the use of controversial weapons, and he has the truculent tone befitting one who constitutes himself the champion of reactionary ideas, and who hopes to make bluster do to a large extent the work of argument. After assailing Prof. Huxley, and with him nearly the whole body of modern men of science, in the geological field at least, on the absurd ground that they had conspired to smother a certain new theory of the origin of coral-reefs, simply because it differed from the one promulgated by Darwin, he turns his attention to Mr. Herbert Spencer, whom he represents as having made, in his "Factors of Organic Evolution," a "great confession" as to the inadequacy of the Darwinian view of the origin of species, and whom he further charges with a persistent effort to degrade philosophy to the lowest possible level. Upon both points the Philistine champion is simply as unjust to Mr. Spencer as it is possible for him to be, and this we propose to briefly show. We invite our readers, however, to turn to the pages of "The Popular Science Monthly" for verification of what we have here to say; for at different times we have published all the more important parts of the controversies now in question, including the Duke of Argyll's article, "A Great Confession," in our number for May, and Mr. Spencer's "Counter Criticism" in that for June.

To make "a great confession" must mean—if it means anything—to acknowledge some serious error on one's own part. To assert the deficiencies of another man's theories is not to make a great confession or any confession. Now, Mr. Spencer's work on "The Factors of Organic Evolution," far from being a confession of error on his own part, was an attempt to fix attention upon a view of his own which he holds now, as he has done for many years, to be of much importance as a complement to the Darwinian doctrine of the origin of species. If some one who had strongly asserted the all-sufficiency of the principle of natural selection, independently of the action of the principle contended for by Mr. Spencer, that, namely, of the inheritance of functionally produced modifications of structure, had come round to Mr. Spencer's view and published a treatise similar in scope and object to his on "The Factors of Organic Evolution," *that* might have been called a confession. Whether it would have been a "great" one or not would have depended on the writer's rank in the world of thought and the extent to which his previous views had affected scientific opinion generally. In Mr. Spencer's case there was no "confession" at all: on the contrary, there was the reaffirmation of a special view of his own, and a re-enforcement of it by additional arguments.

Had our Scotch Goliath admitted the force of Mr. Spencer's arguments, in so far as they tend to show the insufficiency of the principle of natural selection, pure and simple, to account for the origin of species, it might have been possible to explain his calling Mr. Spencer's recent work "a great confession" by assuming that, in his polemical haste and fury, he saw nothing in "The Factors of Organic Evolution" save a criticism—and a powerful one—on the doctrine of natural selection by the most distinguished of contemporary evolutionists. But, far from this being the case, the champion will not admit that there is any force in Mr. Spencer's arguments, but likens them to "some bit of Bumbledom setting up for Home Rule, some parochial vestry claiming independence of a universal empire." Where, then, does he find the "great confession"? How can arguments to which all force

is denied be twisted into a "confession" damaging to any scientific doctrine whatsoever?

The only "confession" Mr. Spencer makes is one which he would have made at any time during the last twenty years, and that is to the effect that his phrase, "the survival of the fittest," is susceptible of being understood in a wrong sense, if not to the same extent, at least in the same general way, as Mr. Darwin's phrase, "natural selection." This confession, however, his Grace of Argyll does not gloat over. It is at this point that he accuses Mr. Spencer of trying to rob philosophy of all dignifying elements. Mr. Spencer feels that to use language asserting or implying conscious purpose or direction when there is no evidence of anything of the kind beyond the vaguest analogy, is undesirable, and, if needlessly done, wrong. His Grace holds, on the contrary, that any suggestion of design which we discover in Nature should be treasured up and made the most of for purposes of edification. "There are," he says, "as it were, a thousand retinæ (in our brains), each set to receive its own special impressions from the external world. They are all needed, but they are not all of equal dignity. Some catch the lesser and others catch the higher lights of Nature; some reflect mere numerical order or mechanical arrangement, while others are occupied with the causes and the reasons or purposes of these." This is all very nice, but a cautious person will remember that when we ascend to "causes and purposes and reasons" we do so by virtue of a faculty totally different from mere perception—a faculty of the highest possible value when its operations can be checked and its conclusions verified, but of very doubtful value when it expatiates in regions where check and verification are impossible. A hypothetical retina or facet in the brain might conceivably reflect facts or phenomena of an external order; but how another similar mirror in that organ could "reflect" a subjective explanation of the same facts we fail to understand. We fear there is no retina or facet in our brain that can help us in this particular difficulty. The theory of design in Nature, the duke tells us, is "a higher intellectual perception." From our point of view it is not a perception of any kind; it is a synthetical judgment, as fully liable to error as any other synthetical judgment, and one that labors under the special disability of being incapable of verification.

The fact is, that it is not Mr. Spencer who degrades philosophy; it is those who seek to impose their own petty conceptions upon a universe that must ever transcend human thought. Mr. Spencer does not pretend to be able to think the thoughts of God. Men have pretended and claimed to do this in past times—to know the why and wherefore of the Divine actions both in Nature and in human history. But Mr. Spencer has advanced far enough to see that to represent the ultimate power in Nature as having acted thus and thus because, to our apprehension, such a mode of action might plausibly explain the facts, is at once foolish and irreverent. The Duke of Argyll professes to know that a certain uncouth animal living in Madagascar was fitted by the Deity with ears, teeth, a probe-like finger, and a peculiar claw, all for the purpose of enabling it to feed on the larvæ concealed in certain trees. Mr. Spencer only professes to know that an animal of this form does live on larvæ, but he does not say that he has discovered in the construction and habits of the creature a revelation of Divine purpose. He refrains from such a judgment, both from a sense of the inadequacy of human faculties for discovering purposes higher than human, and because he knows by actual experience that an appearance of order and purpose is often the necessary result of purely mechanical causes. Witness, as Mr. Spencer says, the arrangement of the pebbles on Chesil beach. Mr. Spencer

is as ready as any one to recognize purpose where purpose can, without undue presumption, be traced, but he does not see how this can be done outside the sphere of human action. The very conception of purpose he finds too small, and, so to speak, too provisional, too relative to our evanescent thought, to apply to the interpretation of Nature as a whole. The Duke of Argyll, by the extremely harsh and overweening tone of his several recent articles, has judged himself. If he could only be made aware of it, "a great confession" is due from him—a confession of the injustice done by him to the men of science in connection with their reception of Mr. Murray's theory of coral reefs, and the further and special injustice done to Mr. Spencer in representing his latest contribution to the theory of evolution in an altogether false light.

LITERARY NOTICES.

INTERNATIONAL LAW. By LEONE LEVI. New York: D. Appleton & Co. ("International Scientific Series," No. LX.) Pp. 346. Price, $1.50.

THE author's purpose in undertaking this work was to reduce to a code the leading principles of the law of nations, in order, by the diffusion of knowledge and by furnishing a collection of well-established rules on the subject, to prevent disputes and facilitate a resort to international arbitration. Attempts at codification had been made by David Dudley Field and Bluntschli, but their works did not include the positive portion of the law—that resulting from treaties and conventions. Copious summaries of these documents, so far as they bear on the subject of the work, are given in the book. Prof. Levi, who died on the 7th of May last, was eminently fitted for this work. A student of commercial law and of economical statistics all his life, and professor of the former subject in King's College, London, he was regarded as the foremost authority in the world in the statistics of commerce, so that in preparing this manual he was working in a field which he had long cultivated assiduously and with eminent success. The work consists of two parts. The first part concerns the general subject of international law, and includes a chapter on its nature and authority, a review of the progress of international relations from ancient times to the present, with epoch-marks at the Peace of Westphalia, 1648, and the Congress of Vienna, 1815; and a survey of the political condition and present international relations of the chief states of the world, each in its order. The second part contains "Materials for a Code of International Law," with chapters on the "Constitution and Sovereignty of the State"; "Frontiers"; "The State and its Subjects"; "Rights and Duties of the State"; "Equality of States"; "The Sea and Ships"; "International Intercourse"; and "Treaties." The last title is followed by summaries of the treaty-clauses concerning the various subjects of public and private interest coming within the purview of international law, each under its separate heading. These summaries are followed by discussions of "Private International Law," "Means for the Prevention of War," "War and its Effects," and "Neutrality." In the appendix are given the declarations of the powers and regulations on the abolition of the slave-trade, the free navigation of rivers, rank between diplomatic agents, maritime law, and the Treaty of Washington.

MODERN THEORIES OF CHEMISTRY. By Dr. LOTHAR MEYER. Translated from the fifth German edition, by P. PHILLIPS BEDSON, D. Sc., and W. CARLETON WILLIAMS, B. Sc. London and New York: Longmans, Green & Co. Pp. 587. Price, $5.50.

MESSRS. Bedson and Williams have done a good service for English-speaking chemists in making this valuable work more accessible than it was in the German edition. Meyer's "Modern Theories of Chemistry" has undergone considerable modifications, due to the changing aspect of the science since the first edition was published in 1864. As the book now stands, it is an account of the latest developments of the hypotheses upon which chemical work is being carried on. In the last two editions the author has, "by the introduction of the more important empirical data, sought to make the theoretical conclusions arrived at by their aid easier to

follow, and the causes leading to their foundation clearer." The first of the three divisons of the treatise deals with the characteristics of the chemical atoms. The author begins by stating briefly the necessity for holding the atomic theory, and for a knowledge of the atomic weights, and proceeds to discuss the determination of these weights from vapor-densities, from the specific heat of solids, and by means of isomorphism. He then takes up the relations between the properties of elements and their atomic weights, which have led to the grouping known as Mendelejeff's classification. The second part of the work is devoted to the statistics of the atoms, and in this division are discussed forms of combination of the atoms, the law of atomic linking, and valency. In the third division is treated the dynamics of the atoms, or the doctrine of chemical change. Separate chapters of this section are devoted to chemical change produced by mechanical disturbance and by the action of light, to heat and electricity as causes and as effects of chemical change, to the influence of mass in chemical action, and to the stability of chemical compounds. The author considers that the influence of mass has been too little regarded by chemists, but that its importance is being more and more recognized. He expects great progress soon to be made in the direction of chemical mechanics, pointed out by Berthollet at the beginning of this century. Throughout the volume he shows much solicitude that theories shall be recognized as valuable aids to chemical research, but shall not be formed too hastily, nor trusted too implicitly.

FORMS OF ANIMAL LIFE. By GEORGE ROLLESTON, D. M., F. R. S. Second edition, revised and enlarged by W. HATCHETT JACKSON, M. A. New York: Macmillan & Co. Pp. 32+937. Price, $9.

THIS comprehensive treatise is described on the title-page as a manual of comparative anatomy, with descriptions of selected types; and the distinctive character of the book, as the late Prof. Rolleston wrote in his preface to the first edition, seventeen years ago, "consists in its attempting so to combine the concrete facts of zoötomy with the outlines of systematic classification as to enable the student to put them for himself into their natural relations of foundation and superstructure." The present edition of the work was begun by the author in 1879, the rewriting of several portions being intrusted to Prof. Jackson, whom Prof. Rolleston further requested to complete the revision in case he was prevented from doing it himself, and this his death made necessary. The book consists of three sections, the first consisting of descriptions of prepared types, which include the rat and rabbit as types of mammals, the pigeon, ringed snake, frog, perch, and a representative of each of fourteen other classes. The second section comprises descriptions of fourteen plates, four of which are taken from the specimens described in the first part of the work, five others are from specimens of the same animals as described in the first part, but prepared differently, and there are five plates which relate to animals or groups not described before. The remaining two thirds of the volume is devoted to a general account of the animal kingdom, which has a brief classification appended to each class or group, and a bibliography of the most important and recent authorities, which will in most cases give the names of all other accounts worth reading. The two latter features are additions which Prof. Rolleston desired to be made in this edition, and the third chief item of his plan was to enlarge the descriptions of the preparations and accounts of the various classes of animals, and bring them up to the standard of contemporary knowledge. All this has been carried out by Prof. Jackson, though the great length of time which has elapsed since the publication of the first edition has brought with it so many and such vast changes in comparative anatomy that great labor and consequent delay became inevitable.

A CRITICAL HISTORY OF SUNDAY LEGISLATION FROM 321 TO 1888 A. D. By A. H. LEWIS, D. D. New York: D. Appleton & Co. Pp. 279. Price, $1.25.

DR. LEWIS has had occasion to make extensive studies of the Sunday question and its history, and particularly of the substitution in the Christian Church of the first day for the original Sabbath of the seventh day. The fruits of these studies are partly embodied in polemical works which he has written in maintenance of the doctrines and practice of the seventh-day Christians; but

outside of arguments and above them are facts in the form of official documents, civil and ecclesiastical, representing different periods of the history of the Church, that help to show how the prevailing notions and usages regarding Sunday have grown up and been fortified, and are, therefore, of general interest. These facts, which are established by full quotations from the original rescripts, are held to illustrate the real nature of the Sunday question of to-day, and to be fitted to guide to a way of dealing with it; for, the author says, "Every effort to remodel existing Sunday legislation, or to forecast its future, must be made in the light of the past." From the setting forth of the compilation, Dr. Lewis draws the conclusion that the first Sunday legislation was the product of that pagan conception of the Romans which made religion a department of the state. It appears in the form of an edict by Constantine as Pontifex Maximus, A. D. 321, ordering the observance of "the venerable day of the sun," in which no reference is made to Christianity. The first designation of this day of the sun as "the Lord's Day" appears sixty-five years later, or in A. D. 386, in connection with the mention of pagan and imperial holidays "baptized with new names and slightly modified. . . . During the middle ages Sunday legislation took on a more Judaistic type, under the plea of analogy, whereby civil authorities claimed the right to legislate in religious matters, after the manner of the Jewish theocracy." The Continental Reformation made little change in the civil legislation on the subject. The early Anglo-Saxon laws were historically, and therefore, probably, logically, the product of the middle age legislation of the "Holy Roman Empire." "The English laws are an expansion of the Saxon, and the American are a transcript of the English." Thus the author believes that he traces a historic continuity in the legislation from paganism till to-day. "In the Sunday legislation of the Roman Empire, the religious element was subordinate to the civil. In the middle ages, under Cromwell, and during our colonial period, the Church was practically supreme." Any claim that Sunday legislation is not based on religious ground "is contradicted by the facts of all the centuries. Every Sunday law sprang from a religious sentiment"; originally pagan, then gradually modified by the interweaving of the Christian idea of commemorating Christ's resurrection; then in the middle ages making a substitution of Sunday for the Sabbath of the Jewish theocracy. The historical review concludes with analyses of the Sunday laws of the several United States. While argument on Sunday legislation is not intended, the bearing of the book is against it as not being a function of political government; except so far as to preserve civil order, and particularly to repress the liquor-traffic on the day, the leisure of which gives so many opportunities for rioting and criminality.

PRINCIPLES AND PRACTICE OF MORALITY. By EZEKIEL GILMAN ROBINSON. Boston: De Silver, Rogers & Co. Pp. 264. Price, $1.50.

THIS treatise is designed as a text-book, and has grown out of the lectures which the author—who is President of Brown University—has given to his classes in ethics, when no existing text-book was found sufficient for the occasion. Ethical theories have been modified to a marked degree by the exhaustive discussions to which they have been subjected in recent years; and the resultant changes do not pass unobserved in the treatise, but are kept in mind when not formally referred to. Yet existing controversies are touched upon only so far as is necessary for the elucidation or defense of the positions here taken. Distinction is made between the science and the philosophy of ethics, the former being regarded as that which teaches what is moral, the latter as illustrating why it is moral. This brings up the consideration of the sources of moral obligation, or, as the author expresses it, with some originality of language, "the origin of the feeling of oughtness," to which considerable prominence is given, and in the discussion of which may be found the central point of Dr. Robinson's theory. The later theories on this subject—designated as the Hegelian, which makes the standard one of general contemporary recognition, or conventional; the evolutionary, which supposes it to have been developed or evolved; and the historical, which assumes it to be the fruit of experience—are declared insufficient to account for it. While the last two

theories may explain how moral laws and their sanction became known, neither of them goes to their origin; neither explains the imperativeness with which recognized moral law speaks to the human heart. Likewise, no final reason for the enforcement of moral obligation can be found in a Supreme Will, or in the beneficent ends which may be regarded as resulting from actions, or in the egoistic principles, whether rationalist, æsthetic, or sentimental, as are implied in other theories. The real ground of moral obligation is held to lie in the eternal nature of God—"in the immutable moral nature of the Supreme Personal Being who is the original and archetype of all human beings." Of the three parts into which the body of the book is divided, the first is devoted to the ascertainment and distribution of fundamental principles; the second to a discussion of those principles, under the general heading of "Theoretic Morality"; and the third to practical morality.

THE MANUAL TRAINING SCHOOL. By C. M. WOODWARD, Ph. D. Boston: D. C. Heath & Co. Pp. 366. Price, $2.

No one can read Prof. Woodward's book without getting from it an interest in the aims of the manual training schools of America, a belief in their methods, and a respect for their results. The author, who has been director of the Manual Training School of Washington University, in St. Louis, since its organization in 1880, naturally has most to tell about the history and experience of that institution, but he gives much information also about manual training schools of other cities in this country, and similar schools which he has visited abroad. He describes the fittings and tools which the workshops should have, also many suitable exercises in drawing, in bench-work, turning, and carving in wood, and in forging, foundry-work, and machine-shop work, all of which is illustrated with sketches and drawings. The St. Louis school is too young to have much of a record in the success of its graduates in their life-callings, many of them at the time of writing of this book being still students in higher institutions; but the director has collected enough replies to a circular letter to show that those graduates who have been employed beside young men without such training have generally taken higher positions and pay, while their capableness has disposed their employers to prefer such graduates over other applicants for employment. Several addresses given by the author at various times and places, and dealing with special features of the subject, are incorporated in this volume. The closing chapter and the appendices contain plans of the buildings occupied by the schools of St. Louis and Toledo, the courses of study in those schools, and suggestions in regard to administration.

Artistic Modern Houses at Low Cost, by *R. W. Shoppell* (Co-operative Building Association, New York, 25 cents), gives sixty designs, with plans, etc., including those designs the general types of which have pleased the largest number of customers, selected from the other books published by the Association. The estimates of cost range from $650 to $3,875; and the publishers guarantee that the actual cost of construction in each case shall be covered by the estimates which they are prepared to furnish, with detailed plans and specifications.

The Drainage of a House, by *William Paul Gerhard*, C. E. (Boston, Rand-Avery Company), embodies in a neat pocket pamphlet of fifteen pages a summary of the objects to be sought, and the general principles to be observed in providing for drainage and the removal and disposal of all waste waters from the house.

Four prizes were offered by Mr. Henry Lomb, of Rochester, N. Y., several months ago, through the American Public Health Association, for as many "best" essays on designated subjects relative to the health of families, school-children, and workmen. The essays to which the prizes were awarded have been published by the Association in separate pamphlets, at ten and five cents each, and together, in a bound volume, thoroughly indexed, at fifty cents. They are *Healthy Homes and Foods for the Working-Classes*, by *Victor C. Vaughan*, M. D., in which are considered the location, adaptation to it, arrangement, heating and ventilation, water-supply and disposal of waste, care, and all other points about the house in which questions of health may be involved, and discussions of the value and healthful-

ness of the various animal and vegetable foods.—*The Sanitary Conditions and Necessities of School-Houses and School-Life*, by *D. F. Lincoln*, M. D., in which the various features of school-house construction are considered from the point of their bearing on the health of pupils, and the care of the eyes, seats, desks, and positions, physical training, and the effects of school-life and school-work on the nervous system are especially considered.—*Disinfection and Individual Prophylaxis against Infectious Diseases*, by *George M. Sternberg*, M. D., U. S. Army; and *The Preventable Causes of Diseases, Injury, and Death in American Manufactories and Workshops, and the best Means and Appliances for preventing and avoiding them*, by *George H. Ireland*. These essays are written from the practical point of view, and for the purpose of being read and acted upon by plain men, with style and matter well adapted to that object. They are published by Irving A. Watson, Secretary of the American Public Health Association, Concord, N. H., and the American News Company, New York.

In the *Practical Lessons in the Use of English for Primary and Grammar Schools*, by *Mary F. Hyde* (D. C. Heath & Co.), instruction in composition is expected to be begun in the third year primary. The scheme of the lessons is intended to be progressive, and to involve constant practice in the correct use of all the parts of speech, the placing of the words in their proper relations, and the right employment of the usual punctuation-marks. The aim has been to lead the pupil to see for himself, to direct his attention to the use of language as the expression of thought, and to teach him to avoid errors by being trained from the first to use correct forms—not by placing before him incorrect forms for correction. These purposes are well brought out. The study is not confined to detached sentences, but passages from good writers are also introduced.

We have already commended the cumulative method of teaching languages of Prof. *Adolphe Dreyspring*. In the *First German Reader*, on this method (New York, D. Appleton & Co., 70 cents), the author has constructed a narrative presenting the varied activities of childhood in plain, simple, and facile language, with rapid succession of interesting and critical events, and the additional attractions of frequent, simple, but expressive outline illustrations. The motto of the cumulative system, "Repetition the mother of studies," is faithfully adhered to. The style of the narrative is flowing and pure, the vocabulary is limited, and every effort has been made by the author to compose a book which young students will like, and to make the road to knowledge as free from difficulties as possible.

The practical part of the *Geography for Schools*, by *Alfred Hughes* (Clarendon Press, Oxford, England; Macmillan & Co., New York, 50 cents), is based on the results of several years' experience at the Manchester Grammar-School. It consists chiefly in the inclusion of problems to be worked out by the pupil, which depend largely upon reference to the atlas and the use of common mathematical knowledge. The problems involve questions of latitude and longitude, distances on the earth's surface, the rotation of the earth, the apparent movements of the fixed stars and of the sun, the seasons, altitudes of the sun, length of day and night, movements of the earth, length of shadows, etc. The constant references to the atlas required are found useful in promoting the knowledge of descriptive geography.

Robert Seidel's work on *Industrial Instruction*, which has been translated by *Margaret K. Smith* (Heath, 80 cents), is a defense of manual training against objections raised against it in the Synod of the Canton of Zurich, in 1882 and 1884. The author maintains that industrial instruction has "a great educational value; a significant mental and physical disciplining power; and a deep-reaching social and moralizing influence."

Slips of Tongue and Pen, by *J. H. Long* (Appleton, 60 cents), is a convenient little manual, which points out many common errors of speech and writing, explains the appropriate uses of words often confused, and includes suggestions on composition and notes on punctuation. The matter is arranged more attractively than in the regular style of reference-books, and illustrations are given of both the correct and the incorrect uses of the words treated.

The pamphlet on *Seminary Libraries and University Extension*, by *Herbert B.*

Adams, of Johns Hopkins University (N. Murray, 25 cents), gives an account of the German practice, which is spreading among American universities, of making special collections of books for the use of students in special branches of study. It contains also a short paper advocating the extension of the system to public reference libraries, in connection with courses of lectures, and another describing the similar practice arising in England under the name of university extension.

Mr. *Edward Potts's* monograph on *Fresh-Water Sponges* (Philadelphia: *Academy of Natural Sciences*) has been prepared for the purpose of describing genera and species, mostly North American, that have been discovered since the publication of Mr. Coates's "Description and Classification" (London) in 1881; to give the results of the examination of the character and variations of already known North American species, and for use as a book of reference on all "good" species. The author further hopes to revive, among lovers of Nature, the appreciation of the existence of sponges in our fresh waters; and to show how to find, collect, classify, and preserve them.

Skeleton Notes upon Inorganic Chemistry, by *P. de P. Ricketts* and *S. H. Russell* (John Wiley & Sons, New York), is a book of blanks for preserving notes of lectures, experiments, or studies. The present volume is labeled Part I, and is devoted to the non-metallic elements. A definite number of pages is allotted to each element, the section being preceded by a table giving the ascertained constants and properties of the element, its applications, and its principal binary compounds.

Of the *Course of Lectures on Electricity* by *George Forbes* (Longmans, Green & Co., London and New York, $1.50), five were delivered in 1886 before the London Society of Arts, and the sixth—which shows the applications of the general principles to one department of practical engineering—was delivered at the Electrical Exhibition in Philadelphia in 1884. The lectures were intended to meet the desires of an intelligent audience, ignorant of electrical science, but anxious to obtain sufficient knowledge to enable them to follow the progress now being made in it; and the attempt is made to present in clear language the fundamental facts governing electrical phenomena in such a manner as will leave the reader nothing to unlearn.

In *Loomis's Contributions to Meteorology Reviewed* (K. Kittredge, Ann Arbor, Mich., 50 cents), *H. Helm Clayton* has compiled a summary of the series of papers which Prof. Loomis has published in the "American Journal of Science and Arts," and which are collectively pronounced "one of the best pieces of work in inductive meteorology of the present age." This summary, covering the chief results of the discussions, is intended for those persons who have not access to the papers in their complete form.

The *Conferencias Filosóficas*, or Philosophical Lectures; second series, Psychology, of *Enrique José Varona* (Havana), comprises a series of thirty lectures which were given in the Academy of Medical, Physical, and Natural Sciences of Havana in 1880 and 1881, and have been already printed in various numbers of the "Revista de Cuba." The opening lectures explain the general principles and foundations of the science, and the importance of the phenomena of movement to its study. They are followed by discussions of the various corporal senses in their order, and then by their relations and qualities of sensation and perception, memory, representation, association, imagination, the emotions and sentiments, the processes of determining and acting, suggestions respecting classification, and a bibliography.

Prof. *Balfour Stewart* and *W. W. H. Gee* have undertaken a series of small books on *Practical Physics*, of which vol. i, *Electricity and Magnetism* (Macmillan, 60 cents), has already been issued. This volume is based on the one devoted to the same subject in the "Elementary Lessons in Practical Physics" by the same authors. It is a laboratory manual, consisting largely of simple experiments and measurements in electrostatics, magnetism, and current electricity, the principles of which are at the same time explained to the student. In order to make the book complete in itself, a chapter is inserted describing the use of scales, calipers, wire-gauges, the balance, etc. In the appendix will be found plans of certain school laboratories, a list of apparatus, tools, and materials, and other information that should be

of value to the teacher. The book is designed for schools and the junior students of colleges, and is intended to facilitate the employment of practical physics as a training for the mind.

Under the title *The Child and Nature*, a book has been issued by *Alex. E. Frye* (Bay State Publishing Co., Hyde Park, Mass.), setting forth a method of teaching geography in which sand-modeling is an important feature. The author maintains that pupils should be led to regard the land areas as possessing not only length and breadth, but also the very important dimension of height, "which divides the surface into the great slopes that form the river-basins, determine rainfall and drainage, distribute soil as food for plants, and thus prepare the earth to become the home of man." He advises that the study begin with modeling the district about the school-house, and shows by illustrative lessons and lists of questions how ideas of the forces acting upon land and water, of the plant and animal life, and of human occupations and interests in the vicinity, may be developed. As the next step he puts the study of the earth's surface as a whole, "first, because the globe is the *simplest* whole; and, second, because the globe study alone can lead to those relations to heat, winds, and rainfall which enable the pupil to take the next step in the science." The continents, he says, should be studied later as parts of the globe structure. As with the district, he shows how the subjects of forces, life, and man are to be taught in the department of foreign geography.

Three Kingdoms: a Handbook of the Agassiz Association, by *Harlan H. Ballard* (Writers' Publishing Co., New York, 75 cents), was written "to serve instead of a personal reply to the inquiries concerning the Agassiz Association." It comprises first an account of the organization, whose object is to aid young people in the collection, study, and preserving of natural objects and facts; then directions for organizing a chapter of the Association and a plan of work. In the following chapters are given suggestions for work with plants, insects, birds and their eggs, minerals, and archæological specimens. Exchanging specimens, books to read, taking notes, more about the Association, and various hints and helps, occupy the remaining chapters.

The first of a series of "Nature Readers," with the title *Sea-side and Way-side*, has been written by *Julia McNair Wright* (Heath, 25 cents). It is intended for children who are beginning to read, and consists of descriptions in simple language of the structure and habits of insects and shell-fish, its peculiar aim being to interest the child in natural objects while he is learning to read.

Profs. *Oscar Oldberg* and *John H. Long* have published *A Laboratory Manual of Chemistry* (W. T. Keener, $3.50), for students of medicine and pharmacy. As described in the preface, "it contains experiments intended to familiarize the student with the properties of the principal elements, lessons in synthetical chemistry, a systematic course in qualitative analysis, examples in quantitative determinations, including the official methods of assay for a few important drugs, and a short chapter on the chemical and microscopical examination of urine." An appendix contains lists of apparatus and reagents, and tables of weights, solubilities, etc. The volume is illustrated with figures of apparatus, and plates showing the appearance of various crystals, corpuscles, casts, etc.

Photography applied to Surveying, by Lieutenant *Henry A. Reed*, U. S. A. (Wiley, $2.50), is a treatise on a subject on which little seems to have been yet published outside of France. The author, having been strongly impressed with the value of photography in his own practice, has prepared an account of the method for the use of surveyors in this country. He describes the instruments and materials required, and the mode of procedure, in the methods by plane perspectives, cylindric and radial perspectives, and gives an account of telescopic and balloon photography. He states as the advantages of photographic surveying that the field-work may be performed with great rapidity, and with an economy of men and material unattainable by other means; there is no fear of having omitted some important point, and no occasion for rejecting doubtful observations; the plotting presents no difficulties, and abundant means of checking results are afforded. The volume is a thin quarto, and is illustrated with fifty-eight cuts and a photographic map.

Dr. *C. W. Dulles's* little manual on *Accidents and Emergencies* (Blakiston, 75 cents) has reached a third edition. It has been revised and enlarged, and new illustrations have been added. The aim of this book is not to take the place of calling a physician or surgeon, but to fill up with helpful action the interval before skilled assistance arrives. It contains information which every one is liable to have a sudden need for during the present season of travel and more or less dangerous sports.

From the same publishers comes the sixth American edition of Dr. *T. H. Tanner's Memoranda on Poisons* (75 cents), which has been revised by Henry Leffmann, M. D. Obsolete portions of the text have been omitted, and some new matters of importance have been added. The toxicology of poisonous food has been rewritten. This manual is for the medical practitioner, and contains, besides directions for the diagnosis and treatment of poisoning, also a statement of his duties with reference to obtaining information for a judicial inquiry.

Mr. *F. B. Goddard* has written three pamphlets for the guidance of the householder, dealing with *Furniture and the Art of Furnishing*, *Marketing*, and *Grocer's Goods* (Tradesman's Publishing Co., New York, each 20 cents). They are full of practical information in regard to qualities, imitations, prices, uses, and care of the various goods and supplies described, which will save the inexperienced buyer many times the cost of the pamphlets.

The Story of New York, by *Elbridge S. Brooks* (Lothrop, $1.50), is the first volume in "The Story of the States" series. It aims to give the reader an acquaintance with its field, by presenting to him the stages of growth through which the State of New York has passed. The progress of the average citizen through the changes of over two hundred years is represented by the story of a hypothetical Knickerbocker family, which is woven in with the historical data. The author has been more solicitous to make a readable book than to crowd a great number of facts into a small space, and is much aided in this respect by the many illustrations.

The negro literature of our Southern plantations has been increased by a volume of *Negro Myths from the Georgia Coast*, which have been recorded by *Charles C. Jones, Jr.* (Houghton, Mifflin & Co., $1). The stories of the negroes in the swamp region of Georgia and the Carolinas have a character of their own, differing from those in vogue among the negroes of middle Georgia, which have been recounted by Mr. Joel Chandler Harris. The stories of this collection are short, and are told in vernacular. A glossary is appended to the volume.

PUBLICATIONS RECEIVED.

Agassiz, Alexander. Three Cruises of the U. S. Coast and Geodetic Survey Steamer Blake. Houghton, Mifflin & Co. 2 vols. Pp. 314 and 220. $8.

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POPULAR MISCELLANY.

The Organization of the Geological Survey.—The statement of the organization, business methods, and work of the Geological Survey, prepared by Major J. W. Powell, the director, in response to the inquiries of the Senate Select Committee on the Executive Departments, gives a very detailed account of that bureau. The Survey was organized in March, 1879, with Mr. Clarence King as director, who was succeeded in March, 1881, by Major Powell. The function of the Survey is "the geological survey and the classification of the public lands, and examination of the geological structure, mineral resources, and products of the national domain, and to continue the preparation of a geological map of the United States." For the prosecution of these researches, there have been organized a division of geography, divided into several sections, a number of divisions of geology and paleontology, and several miscellaneous divisions, namely, chemistry and physics, petrography, mining statistics and technology, forestry, illustrations, and library and documents. The funds for the support of the Survey are appropriated by Congress from year to year, the amount for the current fiscal year being $502,240. Before the beginning of each year the plan for the year is formulated by the director, after conference with the heads of the various divisions and sections, and a stated sum is allotted to each head officer for prosecuting the work in his charge. In large measure each chief is an independent investigator, and, since all reports or maps made by him are published under his name, he has a strong incentive to do all that can be done with the money allotted; his work, however, is under the general supervision and control of the director. The fiscal operations of the Survey are in charge of a chief disbursing clerk, and there are twelve disbursing agents acting under his general direction. Nine of these belong to the scientific staff, and merely add the labor of disbursing to their other duties. There is also a class of agents, made up mainly of chiefs of divisions and their scientific assistants, who are charged with the custody of all property owned by the Survey. This class of agents is made so large that each individual may have personal knowledge of every article with which he is charged. Collections of minerals made for study in the several divisions are ultimately transferred to the United States National Museum, with the exception of material that would be useless in a museum. In the division of illustrations, a number of assistants are employed upon drawings and the proof-reading of engravings. There is a photographic laboratory belonging to the division in charge of a photographer who has four assistants. This force does not include that employed in the section of topographic drawing in the division of geography. The labor of preparing the manuscripts for the

press, and of careful reading of the proofs of the large amount of the Survey's publications, has made necessary the development of an editorial system. During the year 1886–'87 there was published an aggregate of 4,253 pages of text, illustrated by 350 plates and 327 figures. These publications consist of four classes, viz., annual reports, monographs, bulletins, and statistical papers. At the date of this statement, five annual reports, eleven monographs, thirty-five bulletins, and two statistical papers had been issued. The monographs are in quarto form, the other books in octavo. The custody of the documents distributed through the Survey is vested in the librarian, and accounts are kept of the number of copies received from the public printer, and sold, exchanged, or given away. A printed letter of transmittal, with a blank receipt and an envelope for its return, is sent out with each copy. The Survey maintains a geologic library for use in the prosecution of its work. The library last year contained 19,501 volumes, 26,100 pamphlets, and 8,000 maps. The facilities afforded by this collection are being utilized in the preparation of two geologic bibliographies by the library staff. The librarian has eleven assistants. In the principal office of the Survey, at Washington, there are employed in the work of the Survey from 70 persons in summer to 225 persons in winter, in a building of 78 rooms, on five floors.

"Feeding for Fat and for Lean."—Dr. Manly Miles, criticising the reports under the above title of experiments in pig-feeding made at the Missouri Agricultural College, and the Wisconsin Agricultural Experiment Station, fails to find any practical results in them which are both new and reliable. He quotes some of the results obtained in the extended feeding experiments conducted by Sir John Lawes and Dr. Gilbert at Rothamsted, and points out, among the indications which they give, that the nitrogenous substance of the animal's increase in weight bears no direct relation to the amount of nitrogenous substance of the food consumed. Also, in the words of the experimenters, "that, with an excessive proportion of nitrogenous substance in the food of the fattening pig, we have found there was more of a tendency to grow in frame or flesh, than in other cases; and again, that the larger the proportion of flesh in the increase, the less will be the proportion in it of real dry substance." Further, when fattening foods contain an ordinary amount of nitrogenous substance, "it is their available non-nitrogenous constituents which rule both the amount of the food consumed and the increase in live weight produced." The pigs fed on corn-meal exclusively at Rothamsted did not do well until a mixture of coal-ashes, salt, and superphosphate of lime was given them, but this gave the most satisfactory results both as to the health of the animals and their progress in feeding. In the Missouri and Wisconsin reports of experiments, little attention is given to the proportion of mineral constituents in the food, which Dr. Miles deems an important omission, especially in the case of growing animals, that should make some increase in bony tissue. He regards corn-meal as undoubtedly deficient in ash constituents, and his own experience has been that, when feeding it alone, the most satisfactory development of muscle as well as bone has been obtained when the pigs had access to some bone-ash, leached wood-ashes, or other similar mineral matters. It is likewise a common practice among farmers of his acquaintance to provide some mineral "relishes" for their pigs when their food consists largely of corn.

Execution by Electricity.—The new law of the State of New York substituting execution by electricity for hanging was drawn in conformity with the report of a commission, consisting of Elbridge T. Gerry, Alfred P. Southwick, and Matthew Hale, which was appointed by the Legislature to investigate the most humane method of inflicting the death-penalty. The report contains, first, a brief history of capital punishment from the time of Moses to the present day; second, objections to the five modes of execution now employed by civilized governments, followed by a discussion of proposed substitutes, with a recommendation of electricity. From the opinions of experts and the results of experiments on dogs, the commission concluded that "death produced by a sufficiently powerful electric current is the most rapid and humane produced by any

agent at our command," and that "the apparatus to be used should be arranged to permit the current to pass through the centers of function and intelligence in the brain," resuscitation under such conditions being impossible. As to the appliances, the commission said: "All that would be essential would be a chair with a head- and foot-rest, in which the condemned could be seated in a semi-reclining position; one electrode would be connected with the head-rest, and the other with the foot-rest, which would consist of a metal plate." The current of electricity might be supplied from the wires used for street-lighting, or from an independent plant at the place of execution. The most effective machines for the purpose are those known as "alternating machines."

Mound-Builders' Units of Measure.—Mr. R. P. Gregg, of Buntingford, Herts, England, has made investigations concerning the units of measure among certain ancient nations, including those of America. He concludes that the Peruvians of the time of the Incas, the Aztecs, Toltecs, and Central Americans, employed a common measure, comprising a foot equal to 11½ inches English, or a fraction more than the old Roman or Solon's foot, which foot, = 0·298 of a metre, was divided into twelve equal parts. These feet, being to English feet as 100 : 102, are reducible by simply adding two per cent. The mound-builders' measure, as derived from a curious tablet found in Cincinnati in 1841, and from implements described by Dr. Abbott and the investigators of Ohio mounds, consisted of a foot equal to ten English inches, or 0·254 metres, which was divided into twelve mound-builders' inches, seven of which were equivalent to six Mexican inches. Incidentally, the author has reason to suppose also that the mound-builders' acre, or larger unit of superficial measure, was equal to from 1⅛ to 1$\frac{7}{16}$ English acre, with square side of 300 mound or 250 English feet, and that the favorite square and circle areas of 20, 27, and 40 (or 41) acres English, meant 15, 20, and 30 mound acres respectively. A third unit was the prehistoric measure of North America, the inch of which was intermediate between the mound inch and the Mexican inch, and of which the author is not certain whether there were eleven or twelve to the foot. As no mound-builders' measures have so far been found in Central America, Peru, or Mexico, that people are apparently excluded from the presumption of ever having lived there; but from the occurrence of the southern measures along with those of the mound-builders in the latter's country, it would seem to follow "that the mound-builders, and the people allied to, or the ancestors of, the Toltecs, etc., must have, perhaps some two thousand years ago, coexisted and lived together in large parts of America, extending from New York to Ohio and Tennessee, and not been exclusively confined to the mound districts *par excellence*."

Flower-Farming.—Flower-farming and the manufacture of essences constitute a special industry in southern France. The principal center of the business is at Grasse, in the *Alpes Maritimes*, but it branches out into other districts. The flowers grown include the violet and jonquil, which are gathered in winter or early spring, roses, orange-blossoms, thyme, and rosemary, in May and June, jasmines and tuberoses in July and August, lavender and spikenard in September, and the acacia in October and November, so that the season may cover three quarters of the year. Thyme, rosemary, and lavender are usually side-products, grown by farmers of the grape and olive, who distill from them inferior essences, which are used to dilute and adulterate those of superior quality. According to Consul Mason, of Marseilles, the best situations for growing perfume flowers are at altitudes of from five hundred to two thousand feet. Flowers grown on such elevated positions are said to be richer in perfume than similar varieties that bloom in valleys and lowlands. The plantations want to be provided with a soil rich in calcareous elements, and to be sheltered from cold winds. The rainfall being scanty, irrigation is necessary. All fancy and "improved" varieties of flowers are discarded, and the natural, simple, old-fashioned kinds alone are grown. Middlemen go through the flower districts every day during the season, and deliver the flowers to the distillers while they are yet fresh and crisp. The manufacture of perfumes includes the making of pomades and

oils by the process of absorption, and of essences and essential oils by distillation. To make pomade, a square frame or *chassis* of white wood, about twenty by thirty inches, is set with a pane of strong plate glass. On either side of the glass is spread a thin, even layer of purified and refined grease. These frames are prepared beforehand, and kept for the time of the flowers. This having arrived, the petals are picked from the blossoms and laid so as to cover the grease in each frame. These are piled one upon another so as to fit closely together, when there is formed a kind of tight chamber, the floors and ceilings of which are of grease exposed to the perfume of the flower-petals within. The grease absorbs the perfume, while the spent flowers are removed daily and fresh ones supplied for two, four, or five months, according to the strength of perfume desired in the pomade. The perfume may afterward be extracted from the pomade by alcohol, when it becomes a floral water or extract. Coarser pomades are made by boiling the flowers in the grease, and subjecting the residue to pressure. The spent pomades are used for toilet purposes, and in the manufacture of fine soaps. When perfumed oils are wanted, superfine olive-oil is used, and cotton cloths saturated with it take the place in the *chassis* piles of the grease coating on the glass. Essences and scents are produced by ordinary distillation.

The Best Asphalt.—No artificial mixture of bitumen and calcareous matter, says Mr. W. Y. Dent, in a lecture before the Society of Arts, is so well adapted for the description of asphalt used for road-making purposes as the natural deposits found at Val de Travers and at Seyssel. Its superiority is possibly due to the perfect manner in which, by the enormous pressure to which the deposits have been subjected, the ingredients of the rock have been incorporated. The native asphalt rock consists for the most part of carbonate of lime, more or less impregnated with bitumen, the quantity of which varies from about six to twelve per cent, that from the Val de Travers, in the canton of Neufchâtel, containing rather more bitumen than that of the Seyssel. The prepared asphalt, as sold by the makers under the name of "mastic," is made by crushing the asphalt rock under a steam-hammer and grinding it to powder by edge-runners. The powdered rock is then carried forward by means of an endless screw to cast-iron vessels placed over a fire, in which it is mixed with suitable proportions of fine sand and bitumen and kept constantly stirred for two or three hours, when it is run into blocks weighing about one hundred and twenty pounds. When the mastic is used it is reheated with more bitumen, and coarse sand is added to it in quantities, according to the purpose to which it is to be applied. Coal-tar pitch is not an entirely satisfactory substitute for bitumen in this mastic, because when hard it is too brittle, and when warm is too soft and sticky.

Geography and its Related Sciences.—Mr. H. J. Mackinder would define geography as the science whose main function is to trace the interaction of man in society, and so much of his environment as varies locally. According to Mr. Bryce, the environment comprises the influences due to the configuration of the earth's surface; those belonging to meteorology and climate; and the products which a country offers to human industry. The first of these categories depends more largely than has been acknowledged on geology, and is related to physiography, which asks, "Why is it?" to topography, which asks, "Where is it?" to physical geography, "Why is it there?" and to political geography, "How does it act on man in society, and how does he react on it?" and itself asks, "What riddle of the past does it help to solve?" We may stop short at any of these questions, but can hardly answer a later one with advantage unless those which preceded it have been answered. Of meteorology, average or recurrent climatic conditions alone—not weather-forecasting—come within the geographer's ken. In considering the productions of a region, the distribution of minerals is incidental to the rock structure. The distribution of animals and plants is pertinent in so far as those organisms form an appreciable factor in man's environment, and in so far as it gives evidence of geographical changes, such as the separation of islands from continents and the retirement of the snow-line. But the study of the distribution of animals

and plants in detail, and as illustrating evolution, is in no sense a part of geography. Geography and history are related in their elementary stages, but diverge in their higher stages. The geographer must furnish to the historian the ideas and facts in science which he requires, and must go to the historian for the verification of the relations which he suggests. The body of laws governing those relations, which might in time be evolved, would render possible the writing of much "prehistoric" history. Mr. Green's "Making of England" is largely a deduction from geographical conditions of what must have been the course of history.

Water-Spouts in the Atlantic.—Many interesting reports in regard to water-spouts, sighted by masters of vessels during January and February off the Atlantic coast of the United States, have been received by the Hydrographic Office of the Navy Department. Water-spouts are a special class of whirlwinds, and their manner of formation is described as follows in a supplement to the "Pilot Chart of the North Atlantic Ocean" for March: "A layer of warm, moist air at the surface of the ocean happens to have above it a layer of cooler, drier air. This condition of things is one of unstable equilibrium, and sooner or later the warm, light air at the surface rises through the cooler and heavier air above. This process sometimes takes place gradually over large areas, but at other times it is more local, and there seems to be formed in the upper layer a break or opening through which the air of the lower layer begins to drain upward, as through a funnel. Under favorable conditions—that is, when the differences of temperature and moisture and the supply of warm, moist air at the surface are great—this action becomes very intense, and this intensity is still further increased by the fact that as the air rises its moisture is condensed, the latent heat thus liberated adding to the energy of the rising column of air. Now, as this surface air rushes in and escapes upward through the opening thus formed in the upper layer, it takes up a rotary or whirling motion, the velocity of which increases toward the center or axis of the funnel, and a suction or partial vacuum is created, as indicated by the low reading of the barometer at the center of a cyclone or whirlwind. When a whirlwind is thus formed over the ocean, water is often drawn up the center of the whirl some distance, owing to the suction created, and at the same time the moisture in the air is condensed as it rises, so that the name 'water-spout' is very applicable. Indeed, sometimes a spout will burst over a vessel and flood her decks with water, as a cloud-burst does a mountain-side. When a spout is forming, its upper portion is often visible first, seeming to grow downward from the clouds. By observing carefully with a telescope, however, it will be seen that the motion in the column itself is upward, although the moisture in the air which is rising is condensed lower and lower down, thus rendering the whirl visible lower down continually, and making it appear to be actually descending." That part of the North Atlantic from Cuba to the latitude of Philadelphia, and from the Atlantic coast of the United States to the Bermudas, is pre-eminently a region where water-spouts are liable to occur, owing largely to the warm, moist air lying upon the Gulf Stream, and the cool, dry air brought over it by the northwesterly winds from off the coast. Most of the water-spouts referred to were seen within this region. The Office wishes to receive many full and accurate reports of such marine phenomena, in order that knowledge of them may be increased. The most important observations regarding a water-spout are the temperature of the air and water, the reading of the barometer, direction and force of the wind, and the changes which take place in each while the spout lasts; also, the direction of rotation of the whirl, and an estimate of its size, character, and changes of form, with, if possible, photographs or sketches, however rough, of its appearance at the various stages of its formation and progress.

An Ancient Human Foot-print.—The discovery of human foot-prints in volcanic rocks near the shore of Lake Managua, Nicaragua, under circumstances which seemed to assign them a remote antiquity, has been announced for several years. Dr. D. G. Brinton has described, in a paper read before the American Philosophical Society, a specimen of these foot-prints, sent to him by Dr. Earl Flint, of Rivas, Nicaragua. The volcano of

Tizcapa, which furnished the material forming the tufas on which the foot-prints occur, is one of several in the vicinity which have long been extinct, and whose craters are occupied by deep and still lakes. Dr. Brinton's specimen was taken from a quarry on the lake-shore at a point where the overlying strata present a thickness of twenty-one feet beneath the surface soil. These strata comprise five well-marked beds of tufa, beneath which is a deposit of clay, and below this four more beds, with other accumulations in the seams, of pumice and volcanic sand. A heavy deposit of tufa, lying on yellow sand, is then reached. This is the last in the series, and bears on its upper surface innumerable foot-prints—some deeply imprinted, while others are but superficial impressions. As to the age of the foot-prints, Dr. Flint believes the yellow sand under them to be Eocene, but the small shells which it contains are deemed by Prof. Angelo Heilprin to be more nearly Post-pliocene than Eocene. In view of this, and the indications furnished by the overlying strata, Dr. Brinton concludes that there is not sufficient evidence to remove the foot-prints further back than the present Post-pliocene or Quaternary period.

The Lake-Age in Ohio.—Prof. E. W. Claypole has investigated the series of events that occurred in Ohio and the adjoining region during the final retreat of the North American glacier, and has thrown into one view what is known of these occurrences. The terminal moraine of the great glacier crosses the eastern boundary of Ohio a little north of the Ohio River, and extends west and southwest, crossing the Ohio River near Cincinnati. The ice here dammed the river, and ponded back its waters for hundreds of miles. The banks of the Ohio at Cincinnati rise from four hundred to five hundred feet above the water; hence, in order that the ice may have been high enough to pass over into Kentucky, it must have had in the bed of the river a thickness of five hundred to six hundred feet. In this way was formed a lake, which Prof. Claypole calls Lake Ohio, occupying a large tract of the low lands on both sides of the main stream and its tributaries, extending on the north to the edge of the ice-sheet, and hence covering a large share of the southern and eastern parts of the State, reaching beyond the site of Pittsburgh, with arms running up the valleys of the Alleghany and Monongahela Rivers. Lake Ohio must have had a length of four hundred miles, measured in a straight line, and a width of two hundred. Its outlet was probably near Cincinnati, and followed the valleys of the Licking and Kentucky Rivers to that of the Ohio below the ice-dam. When the amelioration of the climate caused the great glacier to retreat northward, there must have come a time when the dam had melted down so that the water could flow over it. A channel was quickly cut in the ice, and the foundations of the dam were undermined. Finally, the dam broke, and all the accumulated water of Lake Ohio was poured through the gap. Days or even weeks must have passed before it was all gone, but at last the lake-bed was dry. When the ice-sheet had been pushed back north of the water-shed which separates the streams that flow into Lake Erie from those that flow into the Ohio River, the water that came from the melting of the ice was held between the front of the retreating ice and the ridge of the land. Thus in the valleys of the Cuyahoga, Sandusky, Maumee, and other north-flowing rivers, triangular lakes were formed with their bases resting against the ice-wall, and narrowing and shallowing back to the water-shed, where they found outlets in south-flowing rivers. All these lakes left monuments behind them in the form of beds of silt, in which are imbedded stones such as might be dropped by floating masses of ice. As the ice-line shrank back down the slope toward Lake Erie, the bases of these triangular lakes spread until they came in communication with each other, and the chain formed one continuous lake, using the lowest of the several southern outlets which had belonged to the separate lakes. As the bed of Lake Erie became uncovered by the glacier, this ancient lake increased in extent, and there is evidence which indicates that when the ice-sheet had retreated still farther the lake formed one vast sheet of water occupying the beds of Lakes Erie and Ontario, the southern part of the bed of Lake Huron, and much of the surrounding country. There was no escape for this water through the St. Lawrence River; that passage was still blocked by the ice. Where Fort Wayne, Ind., now stands, there is a gap

in the ancient margin of the lake, two hundred and twenty-five feet above the present level of Lake Erie, but one hundred feet lower than any of the outlets of the chain of triangular lakes which had been the nucleus of this great inland sea. Southwestward from this water-gap runs a broad but now almost deserted water-way communicating with the valley of the Wabash River, and by this passage the drainage of the "Erie-Ontario" basin found an outlet to the Mississippi.

The Head-Waters of the Orinoco.—The Guaharibos, an Indian tribe living near the head-waters of the Orinoco, are described by M. Chaffaujon as of small and mean stature, with slender limbs, stomach inordinately distended, long and coarse hair, and bestial physiognomy. They were absolutely nude, and carried nothing but a stick. Their repast consisted of palm-shoots, a quantity of half-rotten fruit, and some balls composed of white ants. Some others, to whom the traveler exhibited at a distance pieces of cloth, knives, etc., fled as soon as he attempted to get near them. The source of the Orinoco was found to be a mountain-torrent springing from a peak which was named Ferdinand de Lesseps, in the Sierra Parima range (3,300 feet high). M. Chaffaujon studied the remarkable bifurcation of the Orinoco by means of the Cassiquiare, whereby a connection is established with the Rio Negro and the Amazon, and found it to be the result of the undermining and washing away of the clay banks of the river during the rainy season. The outlet from the Orinoco descends a few inches every year, and is now nearly half a mile from its original position. In entering the Cassiquiare the current has the same force as that of the Orinoco, but quickly increases in rapidity after traversing the clay deposits. This communication between the two streams is believed to be recent.

The Progress of Cremation.—It is now fourteen years since Sir Henry Thompson proposed cremation as a method of disposing of the dead eminently desirable to be adopted on sanitary grounds. The proposition fell as a shock upon a large part of the public; and it may be recorded as among the curiosities of the human mind that, although there is no conceivable relation between cremation and religion, it was regarded by many persons high in the Church as a covert attack on Christianity. Yet it was not new; for it had been proposed in Italy in 1866, experimented upon by Gorini and Pollini, with published results in 1872, and illustrated, with the display of a model furnace at the Vienna Exhibition of 1873. The Cremation Society of England was formed in 1874. Opinions of legal authorities were obtained to the effect that the proposed process was not illegal, provided no nuisance was occasioned by it. An arrangement with one of the London cemeteries for the erection of a crematory on its grounds having been vetoed by the Bishop of Rochester, an independent property was obtained at Woking, on which a Gorini furnace was erected. A test of this apparatus, made by Prof. Gorini himself in 1879, showed that in it complete combustion of an adult human body could be effected in about an hour, so perfectly that no smoke or effluvia escaped from the chimney, every portion of organic matter being reduced to a pure, white, dry ash, absolutely free from anything disagreeable. Several cremations had in the mean time taken place abroad; one at Breslau and one at Dresden in 1874, and two at Milan in 1876. The Cremation Society of Milan was established in 1876, and soon became popular and influential. It erected a handsome building, with a gas, and afterward two Gorini furnaces, in which four hundred and sixty-three bodies were cremated to the end of 1886. Similar buildings have been built and used at Lodi, Cremona, Brescia, Padua, Varese, and Rome; and in all seven hundred and eighty-seven bodies have been cremated in Italy. The only place in Germany where the practice has been regularly followed is Gotha, where a building was constructed with the permission of the Government, in which four hundred and seventy-three cremations were performed from January, 1879, to the 31st of October, 1887. Cremation societies have been established in Denmark, Belgium, Switzerland, Holland, Sweden, and Norway, and in various parts of the United States. A crematory has been built in Paris, and was first used on the 22d of October last. The English crematory did not go into operation until 1884, after Mr. Justice Stephen had pronounced his judgment that the process was legal, if performed

without nuisance. Suitable provisions were made to obviate the only valid objection to the process—that it might be used to destroy evidences of poisoning—and the first cremation took place on the 20th of March, 1885. Two others followed in that year, ten more in 1886, and ten more to the end of November, 1887. "The complete incineration is accomplished," says Sir Henry Thompson, "without escape of smoke or other offensive product, and with extreme ease and rapidity. The ashes, which weigh about three pounds, are placed at the disposal of the friends, and are removed. Or, if desired, they may be restored at once to the soil, being now perfectly innocuous, if that mode of dealing with them is preferred. One friend of the deceased is always invited to be present, and in almost every instance has expressed satisfaction with the way in which the proceeding has been carried out." The Cremation Society has no thought of making cremation compulsory, but simply by all the means in its power to encourage its voluntary adoption, and to enlarge the opportunities for those who desire it to have their wishes properly carried out. It, however, urges upon all that cremation is eminently preferable—whatever may be the feelings in other respects—in the case of persons who have died of small-pox, scarlet fever, or diphtheria. All cases where the cause of death is in doubt should be rejected at once, except after an autopsy. If the autopsy is objected to by the family of the deceased, the cremationists would avoid the doubtful case without raising an imputation.

India-Paper.—India-paper, which the Chinese call *lehi*, is made from hemp, mulberry-bark, cotton, bamboo, rice-straw, barley-straw, and from the interior membrane of silk-worm cocoons. Sometimes the whole of the stalks of bamboo of a year's growth are used. The pulp is mixed, after it has been prepared, with a given proportion of a vegetable gum called *hotong* in China. The paper is molded in molds made of fine bamboo filament. Those sheets, sixty feet in length, which the Chinese are said to make, are supposed to be fabricated by artfully joining several small sheets at the moment of laying the paper. When taken from the molds, the paper is stretched upon a wall, hollow inside and heated, the surface of which has been coated with a very thin mastic. The application of the mastic is made with a brush, and this accounts for the streaks and roughness that appear on the wrong side of this paper. India-paper, being too thin to bear handling or any strain, is mounted on vellum, which serves as a lining to it, and the white borders of which set it off as a frame would do. The sheets thus prepared are kept in a dry place, far away from the fire, and may be preserved for years.

NOTES.

Prof. Daniel S. Martin has announced a "Geological Map of the Environs of New York City," embracing a region of sixty-eight miles from north to south, and fifty miles from east to west. It includes the whole width of the Triassic belt of New Jersey, with its trappean ridges entire, and its relations to the formations around it; the northern part of the entire series of the New Jersey State Survey's divisions of the Cretaceous; the recent divisions of the New Jersey and Long Island coast region; the Great Terminal Moraine conspicuously laid down; the lines of deep sounding, which mark the submerged pre-glacial channel of the Hudson River; and all other geological features. It measures forty by fifty inches, and is published at a subscription price of ten dollars a copy.

The fourth session of the International Geological Congress will be held in London, September 17th to 25th. Prof. Huxley will be honorary President, Prof. Prestwich President, and the President of the Geological Society, the Director of the Geological Survey, and Mr. T. McR. Hughes, Vice-Presidents. Messrs. T. W. Hulke and W. Topley are the General Secretaries, to the latter of whom communications respecting the Congress should be addressed, at 28 Jermyn Street, London, S. W.

A circular of the Educational Department of Scotland discourages attempts to give technical instruction in the primary schools till the boys have reached the higher standards, and not even then unless skilled teachers and scientific apparatus are attainable. In most instances the thorough teaching of elementary science is beyond the reach of the primary schools; but some of the difficulty may be overcome by several school boards uniting to employ a trained staff of teachers. School boards are advised to seek the aid of local committees composed of manufacturers who know what technical education is most needed in the district.

DR. W. J. HOLLAND, naturalist of the American Eclipse Expedition to Japan, collected 4,000 botanical specimens, representing nearly 800 species, and 6,000 entomological specimens, representing about 1,200 species, mainly Lepidoptera and Coleoptera. He obtained also by purchase the entire collection of Pyralidæ made by Mr. H. Pryer, representing the labors of nearly seventeen years, and containing nearly 4,000 specimens, of more than 375 species, the larger part of them as yet undetermined, and some possibly new to science. This collection of Pyralidæ covers the entire group of the Japanese Islands. The botanical collections exhibit strikingly the wonderful affinity between the flora of Japan and that of the United States.

Two incidents are related by the London "Spectator," which seem to indicate that animals are able to think and carry out a plan. They occurred in India. A rough terrier, when given a bone, was sent to eat it on the gravel drive in front of the bungalow. Two crows had sought often to snatch the meat from the dog, but had always been defeated. Finally, they discussed the matter in a neighboring tree; after which one of them flew down and pecked at the dog's tail, and while he was attending to this matter, the other one came and seized the bone. The same dog had a favorite seat, of which a visiting dog had frequently deprived it. One day, the terrier, having found his seat thus occupied, flew savagely out of doors, barking at a supposed enemy. As the intruding dog rushed out to take a part in the fray, the terrier hastened back to secure possession of its seat.

PRESIDENT WILLITS, of the Agricultural College of Michigan, while he disputes the exercise of a direct influence of forests in promoting moisture—saying that all the trees in the world will not put it where it is not—believes that the moisture on the continent is advancing toward the west, and that the planting of forests and increased cultivation will cause the rainfall to advance farther west every year. Seven hundred thousand acres of forest have already been planted in Nebraska; the cotton-wood and the willow first, and then the soft maple and the hard woods.

Two skeletons of Akkas, from central Africa, representing probably the smallest of the human races, have been received at the British Museum from Emin Pasha. As described by Prof. Flower, though both of full-grown people, they are hardly four feet high, while a woman of the race, measured by Emin Pasha, was still shorter. They are well formed, and present most of the characteristics of the negro race, except that the skull is rather rounder than usual. They appear to belong to the branch of the human race called "negrito," which includes also the smaller tribes of the Indian Archipelago.

THE north side of the Romsdal, Norway, is a magnificent wall of dark-colored rock, ranging at the lower part of the valley from two to three thousand feet in height. Over this are poured a multitude of cascades, some of them mere threads of water. On a clear summer's day the continuous sunshine warms the dark rock so effectually that some of these minor falls, after breaking, as they all do, into snow-like spray, vanish altogether by evaporation.

AUSTRIA, according to a British consular report from Trieste, has a larger proportion of forest to its area than any other country. The woods cover about 3,500,000 acres, of which 80 per cent is timber forest, and the remainder is of young growth. The Government and the large land-owners own 69 per cent of the whole, the parish authorities 20 per cent, the clergy 5½ per cent, and the peasants about 1½ per cent. The total value is estimated at $200,000,000, and the annual increase at $2,500,000.

ACCORDING to the British consul at La Rochelle, since the failure of the vineyards from phylloxera, an imitation of claret is made there by steeping raisins and currants in water and mixing the compound with cheap Spanish wine. In other districts of France, a spurious brandy is made from a mixture of beet-root and cheap German spirit. This, having been sent to a port of exportation in its true character, is re-marked and sent abroad as cognac.

WHY, asks Prof. W. Mattieu Williams, must we suppose the existence of a luminiferous ether distinct from other matter, when it is just as easy to account for the phenomena of heat, light, electricity, magnetism, and chemical force as "modes of activity of ordinary matter, analogous to the waves of sound," but differing from them by being molecular vibrations, while sound is molar vibration? Gaseous matter being infinitely expansible in the presence of radiant heat, there is no difficulty in imagining space filled with ordinary gases thus expanded, and performing all the functions ascribed to the ether.

IN a paper on "Earthquake-Sounds," Prof. Milne suggests that there is a close connection between the sounds that precede the shock and the smaller vibrations that bear a like relation to them. He had counted as many as seven per second of these sinuosities, and believes that we are warranted in assuming the existence of still smaller and quicker vibrations preceding even these. With more delicate seismographs we might be able to catch the very early infinitesimal movements that herald the approach of an earthquake. With thirty or forty vibrations per second, we should have an audible note of very low pitch.

THE sum required to secure the erection of the monument to the chemist Scheele at Köping, Sweden, has been collected.

OBITUARY NOTES.

EPHRAIM GEORGE SQUIER, a distinguished American archæologist and author, died in Brooklyn, N. Y., April 17th. He was one of the first persons, in conjunction with Dr. Edward H. Davis, of Ohio, to undertake a systematic exploration of the ancient mounds and earthworks of the Mississippi Valley, and their joint account of their explorations, published by the Smithsonian Institution, is still the fullest work, and a standard for reference on the subject. He also published a memoir on the Aboriginal Monuments of the State of New York"; accounts of researches among the ruins of Central America and Peru; a "Monograph of Aboriginal authors who have written on the Aboriginal Languages of Central America"; and "Tropical Fibers and their Economic Extraction." He was in his sixty-seventh year. The death of Mr. Squier was followed, on the 15th of May, by that of Dr. Davis, his coadjutor in the preparation of the "Ancient Monuments of the Mississippi Valley," in the seventy-eighth year of his age. Dr. Davis began to explore mounds while a student in Kenyon College, Ohio, and presented papers on the results of his work as society and college exercises. He was encouraged to continue his explorations by Daniel Webster. He opened nearly two hundred mounds in the Mississippi Valley at his own expense, and gathered a large collection of relics, which are now in Blackmore's Museum, at Salisbury, England. He became, in 1850, Professor of Materia Medica and Therapeutics in the New York Medical College.

DR. EMIL BESSELS, the physician and scientific leader of the Polaris Expedition, died in Stuttgart, Germany, March 30th, aged forty years. He was a native of Heidelberg, and first became known through an expedition into the Spitzbergen Sea. In 1871 he took the scientific direction of the Polaris expedition. He was afterward appointed a secretary to the Smithsonian Institution. He was the author of "Scientific Results of the United States Arctic Expedition," "Physical Observations" of the same, a German account of the expedition, and of contributions in American and German scientific journals.

PROF. LEONE LEVI, an eminent English statistician, has recently died at his home in London. He was born in Ancona, Italy, of Hebrew parents, in 1821, and came to England when twenty years old. He originated the movement for the establishment of the Chamber of Commerce in Liverpool, the oldest of institutions of that class. Having lectured for some time in King's College on commerce, he was made professor of that branch. The London "Daily News" characterizes as the three directions in which his work has perhaps been of most public value as being in his exposure of the evils of war, his minute and careful investigation of questions bearing on the wages of the working-classes, and his conclusive dealing with the fair-trade folly in connection with the depression of trade.

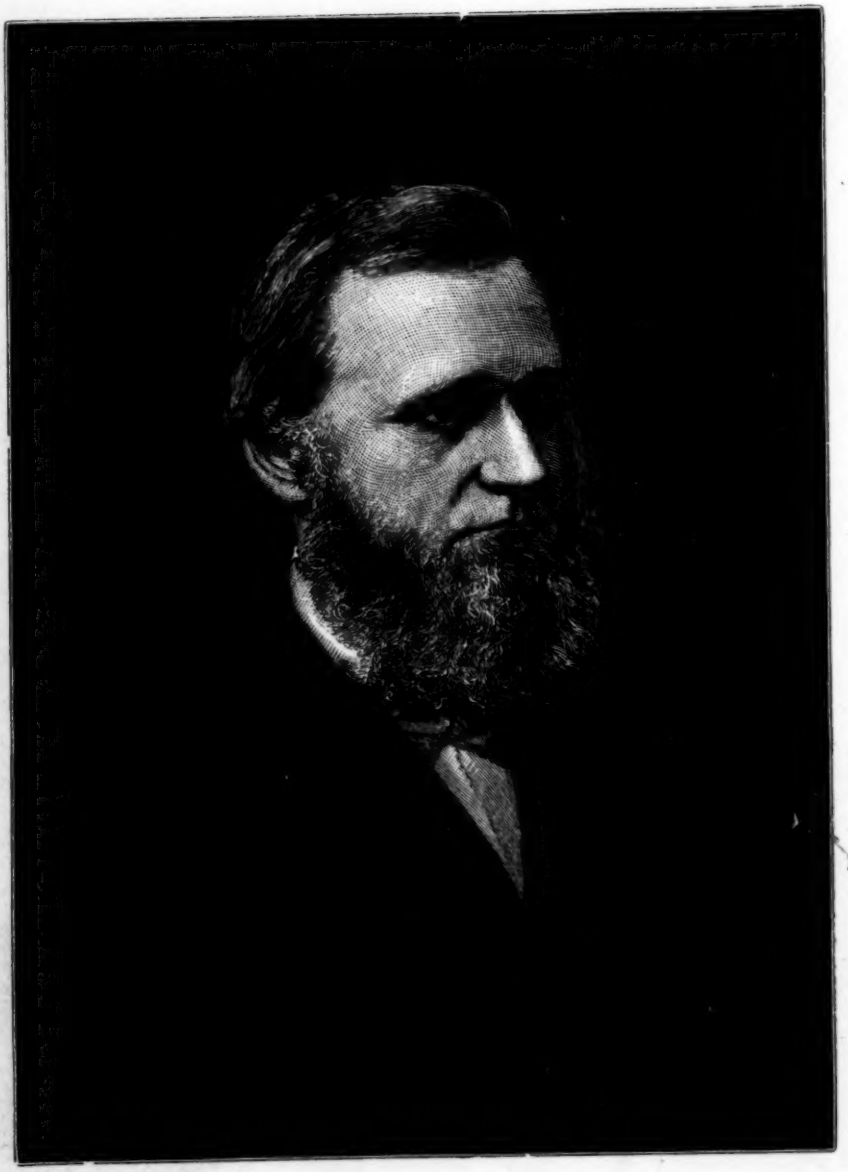
PROF. ALEXANDER DICKSON, of the University of Edinburgh, who died at the close of 1887, was a botanist most distinguished for his investigations of the morphology of several of the conifers, and on the diplostemony of the flowers of the angiosperms; for various contributions to the study of the embryology of flowering plants; for researches on the development of the pitcher-plants; and for various special studies.

DR. GERHARD VON RATH, the eminent German mineralogist, died in Coblentz, April 23d, while on his way to the East on a scientific expedition. He was born in 1830, was appointed a professor at Bonn in 1863, and became recognized as the most distinguished representative of mineralogical science in Germany.

THE death is reported of Surgeon-Major F. S. B. François de Chaumont, F. R. S., Professor of Military Hygiene at the Army Medical School, Netley, England. He was fifty-five years of age.

VICE-ADMIRAL THOMAS A. B. SPRATT, of the British Navy, who has recently died, made many most valuable contributions to geography during his thirty-six years of continuous service in Mediterranean stations, in connection with which he made many surveys and explorations. His chief publications concern these surveys; and his deep soundings and dredgings have been commended as having been essential to the elaboration of Edward Forbes's views on the submarine zones inhabited by different classes of animals.

NICHOLAS VON MIKLUCHO-MACLAY, one of the earliest and most industrious of the explorers of New Guinea, has recently died, at the age of forty-two years. He was the son of a Russian nobleman, and, having studied medicine and natural science at St. Petersburg and the Dutch universities, visited Madeira with Prof. Haeckel, in 1866, and afterward the Canary Islands and Morocco. He spent a year in 1871–'72 in exploring the northwest and southwest coasts of New Guinea; then visited Farther India, Malacca, and various island groups; and, in 1876–'78, explored the northern coast of New Guinea. He visited this island again in 1879, and returned to Russia in 1882 with rich collections. He resided for some time in Sydney, and founded a biological station there.



SPENCER FULLERTON BAIRD.